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HALBERT P. GILLETTE, President and Editor
E. S. GILLETTE, Secretary

R. W. HUME, Vice-President
C. T. MURRAY, Managing Editor

Cleveland Office, 814 Union Mortgage Bldg.: E. C. KELLY, Manager
New York Office, 415 Lexington Avenue: ERWIN T. EYLER, Eastern Manager

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The Most Important Profession

Training the young mentally and physically is perhaps the most important of occupations, yet teachers are badly underpaid. Herbert Spencer would tell us that the primary reason that teachers are underpaid is because they are employed by the public, and that the public is notoriously a poor employer. He would doubtless still advocate the return to private schools, and would point to ancient Greece where one of the highest paid professions was that of teaching. In those early days when science was born, Prof. Aristotle and Prof. Archimedes were not only the most celebrated of Greeks but were among the wealtiest. Their classes were filled with students ambitious to learn the secrets of their ability, and their fees as teachers were proportionate to their reputation as thinkers.

Science and teaching both had a glorious start in Greece, but both suffered a grevious setback as a result of calamatous wars. When science again revived in the days of Galileo, teaching had fallen largely into the hands of the priesthood. Later it became a function of government and has remained so in most countries. There is, however, a possibility that teaching may again emancipate itself from public control.

Suppose some Rockerfeller were to organize a research college and were to employ such men as Edison and the late Luther Burbank as teachers, and were to charge tuition fees that would make the institution not only self-supporting but profitable. Can it be doubted that thousands of parents would send their sons to learn from such geniuses the methods by which their inventions and discoveries were made?

Carnegie thought he was rendering a very great service to humanity when he endowed free libraries; and it was a great service, but it might have been vastly greater had he organized a library company that charged a fee for the use of its books. Then by advertising the wealth of information on its shelves—even as gum and automobiles are advertised—and by showing the public that knowledge is not only power, but its possession a pleasure beyond most others, the Carnegie libraries might have become hives of knowledge seeking men and women, whereas today they now resemble tombs in which mummied knowledge lies in undisturbed and dusty repose.

It is not enough to acquire and to publish knowledge. It must be advertised so that desire for it shall become universal. But advertising is one of the arts that governments have never learned and probably never will. Here and there a Prof. Milliken has secured enough free publicity to attract students, but more than such scattered and unorganized advertising is needed, if scientific education is to become greatly desired.

Dr. Pritchett, President of the Carnegie Foundation for the Advancement of Teaching, has expressed doubt that better teachers would be secured if teachers' salaries were raised. He says that their salaries have increased fully one-third more than the cost of living has increased since 1913 and he argues that teachers enter their calling because they like the work, and that higher salaries would not attract better teachers. Of course he has to admit that teachers themselves disagree with him. And we think that he would have to admit also that experienced employers the world over would disagree with him. Large remuneration is a magnet that attracts brains everywhere. Only one other magnet compares with it in power, and that is the magnet called fame. But few American teachers see either great income or great fame at the end of the rainbow.

In the lower grades of our schools almost all the teachers are women. This is so because their salaries are too small to attract many men. Yet it is universally admitted that boys should come early under the influence of men teachers.

In the higher grades, ambition can best be aroused by teachers who are famous for their originality. And where are they? A scattered few. Yet few they are not because originality is rare but because its rewards for teaching are meager.

The greatest of professions, teaching, is sorely in need of stimulation. Will the stimulus come at last from a public awakening to the importance of securing the best teaching talent, or will it come from a great revival of private teaching by men of genius for profit?

H P Gillette

Successful Macadam Bridge Decks

Los Angeles County Road Department Paving Wooden Bridges With Bituminous Macadam

By W. W. SHELBY
Assistant District Engineer

Los Angeles County has many wooden bridges, the decks of which are covered with various kinds of pavements. Our experience has been that generally speaking, the "hot mix" type will crack, due to the vibration caused by traffic, the degree of cracking varying with the length of span, other things being equal. This has led to the practice of using bituminous macadam pavements, from which we invariably get satisfactory results.

Fig. 2—Applying Oil on Base Rock

Method of Construction.—The pavement here described is on a bridge 697 feet long by 25 feet wide inside of the spreaders and contains eleven Howe trusses. The decking is constructed of 2 by 6 inch plank spiked on edge and is known as a laminated deck. This flooring is creosoted and not surfaced. An unevenness resuits due to the difference in the width of the lumber, the maximum difference being as much as one-half inch, thus giving a decided tendency to prevent movement of the pavement on the deck. A 2 by 12-inch spreader is bolted along the sides of the bridge to furnish a shoulder.

Fig. 1—Smoothing Base Rock

After sweeping the deck, 90 per cent asphaltic road oil is applied hot by a pressure distributor at the rate of ⅜ gallon per square yard. On bridges where the decking is flat and not laminated, less oil is used, usually ¼ gallon. On this oil No. 1 crushed rock (3½-inch to 1½-inch) is spread by dump trucks, the trucks driving over the oil. The spread is evened up and crowned by hand so that it is about 2 inches thick at the spreader and about 4 inches at the center. The 2-inch thickness is obtained by raking out the larger rock along the edges. It can also be obtained by using smaller rock on the outer quarters. Great care is given to the amount of base rock used as well as the shaping of it, for we consider that if the proper section is not secured at this stage it will be difficult, if not impossible, to successfully obtain it later. If the rock contains much round material it is rejected. Nevertheless we generally resort to some cleaning by hand as the locking action on a wooden bridge is practically nil, and simply impossible in the presence of round aggregate. An eight-ton tandem roller now irons out the spread so that any irregularities are apparent. Low areas are brought to grade by the addition of the same size rock.

Rolling is now continued until the rock is firm, bearing in mind that the danger point is reached when the material crushes too much. The best results are obtained by a rock that crushes slightly under the roller. In this particular case twice over proved to be sufficient rolling for the first course. The voids are now partially filled by applying No. 3 crushed rock (¾ to ¼-inch) at the rate of about 1 pound per square foot. If too much filler is used, rolling will force it to the bottom. The writer recalls a recent case where the base rock would not lock, so more

Fig. 3—Spreading No. 4 Rock on Oil

filler was added and the roller was generously used, with the usual result that all the fines went to the bottom and the entire mass had to be removed. The tandem, by one rolling, sets the filler. Oil is applied to this at the rate of ¾ gallon per square yard. As the bottom course varied in thickness from 2 to 4 inches, ⅝ gallon was applied to the thinner portion and ⅞ to the thicker. This oil is covered with a layer of No. 3 crushed rock. It is spread by hand from a maintenance truck and broomed to the proper section. As the quantity used was only about 9 pounds per square foot, no attempt was made to spread by dump trucks. It is rolled by the tandem until well set and firm, rolling being stopped if undue movement of the pavement becomes apparent. Oil at the rate of ½ gallon per square yard follows, this being covered with No. 4 crushed rock (¼-inch to 0). Two or three rollings with the tandem will usually prove sufficient to leave the deck in the proper condition. In some cases a three-wheel roller might be used on the finish, but not at any other stage of the work.

The various operations have been described with much detail, as it is believed the successful laying of this class of pavement on wooden bridges is a difficult task. The principal difference between this decking and a bituminous pavement on a good sub-grade is that satisfactory locking cannot be obtained, but its imitation is attempted by the judicial use of the proper quantity and proper quality of oil. All oil used contained approximately 90 per cent of bitumen.

The weight of a uniform section of well rolled asphaltic concrete pavement three inches thick would be around thirty-seven or thirty-eight pounds per square foot. Hence it appears that this pavement, with a larger percentage of voids, exceeds the average thickness of three inches.

The field work was done by Paved Way Foreman Joe Burkhard, under the supervision of Mr. A. W. Butler, district engineer of maintenance.

Fig. 4—Rolling the Finished Pavement

Costs

Material	Quantity	Total Cost	Cost Sq. Ft.	% Total
Oil—90% bitumen	3,250 gal.	$178.00	.....	.....
No. 1 crushed rock	245 tons	563.50	.....	.....
No. 3 crushed rock	80.5 tons	161.00	.....	.....
No. 4 crushed rock	33 tons	66.00	.....	.....
		$968.50	$0.056	70.9
Labor and Equipment				
Cleaning bridge	.....	$ 17.25	.....	.....
Spreading No. 1 rock	.....	86.15	.....	.....
Spotting No. 1 rock	.....	17.21	.....	.....
Filling voids	.....	23.73	.....	.....
Hauling and spreading No. 3 rock	.....	68.92	.....	.....
Hauling and spreading No. 4 rock	.....	68.92	.....	.....
Rolling, depreciation, etc.	.....	50.10	.....	.....
Maintenance truck	.....	72.00	.....	.....
		$404.28	$0.023	29.1
Totals	.....	.....	$0.079	100.00

Weight of Materials

Materials	Lbs. Per Sq. Ft.	Pct. of Total
No. 1 crushed rock	28.0	68.3
No. 3 crushed rock	9.2	22.4
No. 4 crushed rock	3.8	9.3
	41.0	100.0
Oil	1.4	
Total	42.4	

Pike's Peak Highway to Belong to U. S. in 1935

Public ownership of a motor highway to the summit of Pike's Peak in Colorado, not later than December, 1935, is guaranteed by the action of Secretary Jardine who has accepted the offer of the Pike's Peak Auto Highway Co. to convey to the United States its present highway to the summit of the famous mountain, together with 500 acres of privately owned land and all structures appurtenant to the operation of the road, subject to the reservation by the company of the right of use without competition and at prevailing toll rates until the close of the season of 1935. The offer was accepted in preference to the proposal of W. D. Corley to construct a second toll road to the summit of the Peak, on the opposite side of the mountain, with the understanding that at the end of six years the new road together with the present Corley Mountain Highway from Colorado Springs to Cripple Creek would become public property without cost.

In reaching his decision, Secretary Jardine expressed the belief that a single road to the Peak would be sufficient to accommodate the public; that a second road would cause needless disturbance of natural conditions and involve heavy expenditures for which no economic justification existed; that the division of probable business between two competing roads might make it impossible to maintain or operate either according to proper standards; and that the construction of the proposed new road through the watershed from which the city of Colorado Springs secures its municipal water supply might be detrimental to public health. An additional consideration is the Secretary's belief that all toll roads in National Forests should be made free public highways and turned over to the states for control and maintenance as rapidly as practicable. It is probable that the State of Colorado will be willing to assume the maintenance of one highway to the Peak, but quite improbable that it would undertake the maintenance of two roads serving a single objective point and class of users.

The Pike's Peak Auto Highway Co. secured a permit to construct and operate a motor toll road to the top of Pike's Peak, from the Department of Agriculture, in 1915. The permit provides that in 1940, or at five-year intervals thereafter, the public might assume ownership of the road by paying the cost of its construction. The Auto Highway Co. has now agreed to meet the demand for a public road by conveying to the United States its rights and property under the permit, plus its appurtenant lands and structures, if guaranteed a continued right of use sufficient to permit amortization of its investment.

Pension Funds for Municipal Employees

Recommendations for the Improvement of Chicago's Pension System Analyzed by a National Authority, in National Municipal Review

By GEORGE B. BUCK
New York City

Last summer, George C. Sikes, secretary of the Chicago Pension Commission, presented to the commission a report, at that time admittedly incomplete, outlining the history and containing a volume of data in regard to the Chicago and Cook county pension problems. From the viewpoint of the history of pensions in Chicago and the present status of the various funds, nine in number, the report is very illuminating. To anyone interested in a detailed history of the benefit and contribution provisions of the law, and financial aspects of the various funds, a study of the original report is recommended.

A later supplemental report, entitled "Suggestions Regarding the Organization and Management of Chicago Pension Funds," contains the conclusions based upon the data in the original report. In this report, Mr. Sikes summarizes his recommendations as follows:

1. The reserves of actuarial reserve pension funds should be kept absolutely sacred for their purpose, and distinct from other funds, and not be drawn upon by loan or otherwise.

2. The Public Library Pension Fund and the House of Correction Pension Fund ought to be abolished and their members transferred to the Municipal Employees' Pension Fund. At the least, it should be provided by law that all those hereafter entering the service of the Public Library or the House of Correction should become members of the Municipal Employees' Pension Fund, so that ultimately the Public Library Pension Fund and the House of Correction Pension Fund would disappear.

3. Administrative boards as a rule are nuisances, and should be dispensed with whenever possible and single-headed departments set up in place of them. Most of the work of pension administration is of such a nature that it could be performed better by a single-headed department than by a board. The recommendation is that the work of pension administration—with exceptions hereafter noted—now vested in the Police Pension Board, the Municipal Employees' Pension Board, the Firemen's Pension Board, the Public Library Pension Board, and the House of Correction Pension Board, be transferred to a single-headed department of pensions, or to a division of pensions in the office of the city comptroller. The exceptions are: (1) that the duty of purchasing securities, now vested in the various pension boards, be transferred to the city comptroller; (2) that the power now vested in the pension boards to make awards of duty disability benefit and compensation annuity be transferred to the existing board for administering the Policemen's and Firemen's Death Benefit Fund, said board to be reorganized for the purpose of its new duties. The money for the payment of awards of duty disability benefit and compensation annuity should be appropriated annually by the city council instead of being taken from the revenues produced by the tax levy for pension purposes. The duty of making awards of child's annuity and ordinary disability benefit might be left with the pension fund administering agency, the main function of which is to grant pensions or annuities to employees, or to widows of employees, provided the money supplied by the public for child's annuities and ordinary disability benefits be appropriated annually by the city council and be kept entirely distinct from the reserve funds for pension and annuity purposes. The funds of the various pension boards as now existing should be kept separate, but the administration of the funds named should be brought together in a single office or suite of offices, under a single directing head.

4. Money supplied by the public for expense of administration of pension funds should be appropriated annually by the city council. Pension fund administration should be subject to inspection and supervision by the city council, its finance committee, and the efficiency staff of the finance committee, like the work of other departments for which the council appropriates.

5. There should be an official advisory board made up of aldermen and citizens appointed by the mayor, and of members elected by contributors and beneficiaries. There would be no objection to giving representatives of employees and beneficiaries a majority of this advisory board. It should be the duty of this board to keep close scrutiny over the administration of pension funds, and to consider continuously the need for changes in pension laws suggested by experience.

6. There should be some official agency composed in part at least of pension experts, entirely representative of public interests, to examine all pension proposals presented to the legislature, and to advise the legislature, the governor and the public with respect to the merit or lack of merit of the proposals.

7. The purchase of securities for pension fund investments should be delegated to the city comptroller.

8. Provision should be made by law for thorough inspection biennially of public pension funds by the state insurance department. In addition the Chicago city council should be specifically authorized to provide for inspection at any time of any pension fund directly or indirectly connected with the city government. The agency making the inspection should be given the power to compel the attendance of witnesses, the production of books and papers, and the giving of testimony.

9. If we cannot secure pension fund administration by a single-headed department, but must continue to have board management, appointees of the mayor should constitute a majority of every board administering pension funds for city employees. There should be no ex-officio members of such board or boards, unless the ex-officio member be the head of the department to which the employees belong, such as the fire commissioner for the Firemen's Pension Fund or the superintendent of police for the Police Pension Fund.

Few Benefits on a Reserve Basis.—The author's first recommendation, namely, that "the reserves of actuarial reserve pension funds should be kept absolutely sacred for their purpose . . ." arises out of the fact that even in the five funds which are supposed to be on an actuarial reserve basis certain benefits are still being paid from current receipts and reserves for these benefits are not being accumulated. For example, the Police Pension Fund has six distinct benefits: (1) annuities for policemen, (2) annuities for widows, (3) annuities for children, (4) ordinary disability benefit, (5) duty disability benefit, (6) compensation annuity for widows of policemen killed in the performance of duty. Of these the first two only are on a reserve basis. Mr. Sikes contends, and apparently he is right in his contention, that funds covering reserves on these benefits should be kept for that distinct purpose and not used even as a loan to pay any of the other benefits which are not on a reserve basis. It seems that he might have gone further and recommended definitely putting the other benefits on an actuarial reserve basis. His whole argument implies that he would favor this and it probably is not necessary for him to set this down as a definite recommendation.

The question as to whether the two

funds mentioned in Mr. Sikes' second recommendation should or should not be abolished is purely a local problem. It is fair to assume that any reorganization of an existing pension fund will take into consideration the fact that the members of that fund have been counting on certain definite benefits under existing laws, and the reorganization should, therefore, be of such a nature as to have the least effect on present members consistent with sound financing. The same considerations do not apply as respects new entrants and may be neglected if a majority of the present members express a preference for the suggested plan of reorganization over the plan under which the fund had up to that time been operating.

Board Control.—An examination of Mr. Sikes' third recommendation will show that it is really two recommendations in one: first, a recommendation to abolish control of pension funds by administrative boards, and second, a recommendation to consolidate the administration of all the systems under one head. The majority of pension systems, industrial as well as public, make provision for administration by a board of some sort. Mr. Sikes' proposal to do away with board control and substitute a single-headed departmental control is, therefore, probably somewhat influenced by local conditions. However, from the purely theoretical standpoint, such a method would seem to be equally efficient and one which might be an improvement in Chicago. If, as Mr. Sikes assumes, all questions concerned with the operation of the pension system were definitely provided for in the law creating the system, and if it were always a simple matter to decide whether or not a given case came under the provisions of the law, and, moreover, if it were possible to convince the members of the retirement system that they as individuals would get as reasonable treatment through a single-headed department as through a board-controlled department, it is not unreasonable to assume that the boards could be dispensed with to advantage. Experience seems to indicate, however, that matters do arise which require the exercise of discretion, and members seem to feel that they will receive more equitable treatment from a board on which they are represented than from a single-headed department. It is therefore by no means a foregone conclusion that as applied to pension systems "administrative boards are as a rule nuisances."

As far as consolidating the various funds under one central administering body is concerned, the idea, if practicable, seems good. There is no doubt but that certain general types of problems are common to all systems and there is a serious question whether within a city or a single organization there is not an advantage from centralized control. The question in Chicago is one which must be answered in the light of existing conditions, but theoretically, at least, the recommendation would seem to be a step in the right direction.

All the other recommendations deal with provisions for safeguarding the stability of the pension funds and particularly the safeguarding of the public's interest in the handling of pension problems. They are sound recommendations which cannot help but be of assistance in the future.

The whole report indicates a great deal of thought on the questions raised. There is bound to be some controversy over specific points considered, but, on the whole, the adoption of the author's recommendations could not but help to put Chicago's pension problems on a more scientific and equitable basis. Perhaps before the commission completes its work it will outline a retirement policy for the city which will be sufficiently simple for an interested taxpayer to understand, and which will show what the systems are costing now and what they may be expected to cost in the future. For example, Mr. Sikes states in his detailed report that the police fund costs the city annually a contribution equal to 10½ per cent of the active pay roll to cover the city's share of the liability for two of the six benefits promised, and in addition the taxpayers are to pay the entire cost of the other four benefits. There is no reason why the cost of the other benefits should not be computed as a percentage of the pay roll both as to the regular accruing cost and also as to the accrued liabilities, that is, for the cost of the credit for service prior to the establishment of the system. When figures of this nature are available for all of the funds, the seriousness of the problem will be a little more apparent. The very process of reducing the cost to definite figures tends to clarify the situation and usually aids in the ultimate satisfactory adjustment of the problems which Chicago appears to be facing at the present time. Before any legislation is passed tending to change the funds, it would appear that the city should first develop its policy as to retirement benefits, acquaint itself with its present and prospective obligations, and then propose a definite program which will protect both the taxpayers and the participants in the fund or funds.

Restoring Water Service in Miami After the Hurricane

An interesting account of how the Miami Water Co. of Miami, Fla., resumed its water service after the disastrous hurricane was given by H. H. Hyman, in a paper presented at the recent convention of the American Water Works Association. We quote as follows:

Water for sanitary purposes was of paramount importance, for every hour after the storm had subsided and the water receded from the streets, this unsolved problem of sewage disposal might have developed into epidemic and pestilence, a serious menace to public health that would have been difficult for even Miami's most efficient health department to control. All brains and brawn were concentrated upon one single thought—water—how to restore water at the earliest possible moment. Upon this one fundamental thought hung the safety and security of the lives of many and the health and reputation of Miami. Neither of the company's electric power plants, the one on the causeway and the other in Miami were exempt from the relentless attacks of the hurricane. The chimneys were blown down and the windows blown in. While men were working to remove the debris, scouting parties were sent out in the rain and floods to ascertain the condition of the water pumping stations. It was discovered that none of these could be restored to operation in less than 36 hours or longer. That was too long. The suggestion was made that possibly the Florida Power & Light Co.'s reserve well, which is over 1,200 ft. deep, at the 14th St. ice plant, might be in condition. A scouting party was sent there. The report came back that the well was in good condition and that the motor driven water pump could be reconditioned within a short time. This brought great relief. The boilers were cleaned and fired up and without attempting to repair the chimneys a chance was taken—a chance unknown perhaps in the annals of the electric industry. The power unit was started in operation. It was a fool's chance but the efforts were crowned with success. Before the rain had subsided an electric line was restored to service between the power plant and the ice plant pumping station at 14th St., a little over a mile distant, and water was being pumped into the city mains. Then a line was run to the Golf Course pumping station at 11th St., then to 36th St. and to NE 29th St. The day was won and within 48 hours normal water was again restored in the city. Thus Miami was saved the ill effects of an epidemic that usually follows diasters of this kind.

The hurricane disrupted water service from the Hialeah plant, the main source of supply for Miami, Hialeah and Miami Beach. The Hialeah plant consists of nine wells and a softening and filtration plant—three pumps, two of 10,000 gal. per minute capacity and one of 7,500 gal. per minute capacity—four filters, each of which is capable of filtering 2,500,000 gal. of water a day when operated at a constant rate of 125,000,000 gal. per acre per day or approximately 2 gal. per foot per minute. As soon as electric service could be restored to the Hialeah water plant, operation of this main source was resumed.

Before the storm had ceased, an army of workmen, some 2,000 strong, came, disregarding their personal comfort, convenience and personal danger. These

men labored from daylight to dark and in many instances, as long as 60 to 72 hours in restoring electric service, first to the hospitals and emergency hospitals and the stores and warehouses, for such institutions for the protection of health were on the priority list for service. By Sunday night, Sept. 20th, all the preferred institutions had electric service and thus the herculean task of restoring service was carried on with unparalleled rapidity until every house and every section in the Miami District had water and light. Among the most remarkable in the success of this great feat was the fact that comparatively few men lost their lives.

Six thousand meals a day were served by volunteers to the men of the Florida Power & Light Co., Miami Water Co. and Phoenix Utility Co. in an effort to keep up the strength of the 2,000 workmen engaged in restoring power, gas and water lines in the devastated districts. An improvised dining hall and kitchen was established immediately after the storm on the second floor of the company's garage.

Aerial Maps for Highway Planning

Mapping Erie County, New York, using aerial photographs, with ground controls based on previously surveyed traverses, and an agreement between the two within one per cent on a scale of six hundred feet to one inch as told in Highway Magazine

By GEORGE C. DIEHL
County Engineer of Erie County, New York

In the last decade aerial photography has developed until it has become an almost essential adjunct to the solution of many engineering problems having to do with large areas. Particularly in planning new traffic arteries and allied improvements near large cities, accurate aerial surveys are invaluable.

During pioneer days in the far west there were a certain few individuals who gained reputations as guides because of their undoubted skill as pathfinders in the foothills and mountains. In later years some of them disclosed the means by which they were able to find the best way through uncharted country. It was by making a visual survey of the country from the top of the highest available ground, and noting the course of the principal valley or stream and location of high peaks and intersecting valleys. This picture stored in a retentive mind was the early version of the modern aerial picture.

The aerial survey and map which is being made of Erie County, New York, is primarily for the purpose of a general study of the Greater Motorways System and the preliminary ground location of the various roads comprising the system. The survey was authorized by the Board of Supervisors and is being made under the direction of the county engineer.

For the purpose of an aerial survey, ground controls are necessary, together with a skillful pilot and photographer. To bring photographs to scale they must be taken from a fixed height. Both the plane and the camera must be especially adapted to this use. The photographs are taken vertically from a high altitude, with an overlap which is eliminted when they have been accurately scaled, and built up into a mosaic picture of the terrain included. Previously surveyed lines or traverses across the region may be used for control.

The flying and photography was done at an elevation of 9,600 feet and the finished map is 600 feet to the inch. With few exceptions the control points are two miles, or less, distant from each other. Traverses of existing roads were used for the control. Most of these roads had been surveyed for existing highway improvements and the notes of these surveys were used in platting the control. Nevertheless it was necessary to run many miles of new traverse.

Too much time or money, however, should not be spent on undue refinement for accuracy. This is controlled, though, by the accuracy required of the completed map. The platting of a control map in the ordinary drafting room, to cover 170 square miles of territory on a scale of 8.8 inches to the mile, is quite a labor. The sheets are large and difficult to handle and to retrace the work for the purpose of closing an error in traverse may be time wasted. In attempting to close traverses several miles in length it is readily seen that a failure to close, when the error is less than one per cent, is for all practical purposes accurate enough.

The map was made on the basis of a variation of not to exceed one per cent between the control map and the aerial map with points on the former not over two miles apart. In other words, the aerial map was required to agree with the control map within .088 inch, scaling each way from central points two miles apart.

For the purpose of general study and planning it is at once apparent how trivial one or even two per cent in variation of map distances becomes when the errors are not cumulative and when such error does not exceed 1/10 or even 1/5 inch in open country. Where the control points can be closer together, as in street areas, this error can be reduced to 1/100 of an inch on a 600-foot block, closer than a draftsman can plot it.

The map of Erie County is being furnished in atlas sheets covering an area of 2½ miles east and west and 1½ miles north and south between border lines. This produces sheets 17 by 27½ inches, including binder edges. It also is printed in maps covering about sixty square miles each. The former are for use in the field and office, and the latter for office use only.

Aid in laying out preliminary lines is only one function of an aerial map. In country similar to that around Buffalo the ability to show a property owner where the line is located, and why it is so located, is of more value than the mere location of the line. For these reasons the securing of rights of way becomes one of the most important uses of aerial maps.

Another important use is in legal disputes involving property lines and accidents on public property. In the past summer a serious accident happened near a town park and suit for damages was brought against the town board. Testimony was given, by both sides, that the accident happened at or adjacent to a certain depression. The county engineer had furnished the town with an enlarged aerial map of the locality in question. This map was entered as evidence, the depression located thereon and shown to be off the property owned by the town. The plaintiff lost.

Any engineer or board, working on a general planning scheme, will readily realize how their work can be hampered by conflicting opinions arising from a general distribution of the survey maps before the plans are perfected. Therefore, the advantage of curtailing such distribution is apparent.

It is not meant by this that no one but the officials directly responsible can have access to these maps, but that they must come to our office for such examination. By this means the maps aid in solving individual problems without opening the way to destructive criticism.

Aerial maps have cost Erie County about $100 a square mile, not including the mosaic. The limit of the return on this investment is determined only by the activities of the locality mapped and the people using it.

Can Not Stop Service to Collect Water Bill

Water companies may not discontinue service to a patron as a means of collecting a disputed bill, according to a decision recently handed down by the New Jersey Public Utilities Commission. The case involved a controversy between C. Bellanca and the Middlesex Water Company.

Bellanca's water bill had averaged $2.83 monthly from September, 1925, to May, 1927. The disputed bill involved an average monthly charge of $61.27.

Mr. Bellanca complained to the board and asked for an order restraining the company from carrying out its threats to discontinue service. The board expressed the belief that the controversy should be settled by a court of competent jurisdiction, but in the meantime service to Mr. Bellanca should be continued.

Are City Expenditures Too High?

An Article in "Philadelphia", the Monthly Publication of the Philadelphia Chamber of Commerce

By FRANKLIN UTHOFF

With a few notable exceptions most of our cities throughout the country have reason to be proud of the economy they have exercised in recent years despite distorted and ill-advised reports to the contrary. Some of these reports failed to take cognizance of two significant facts. One is that modern civilization demands and needs civic improvements as never before. The other is that the purchasing power of the dollar is considerably less and the average wage considerably more than it was before the World War.

Thus, when an individual or an organization points out with horror that a municipality or a state is spending for improvements nearly twice as much as in 1913, no mention is made of the facts that the purchasing power of the dollar has been nearly cut in two or that wages have virtually doubled since the so-called "Normal Pre-War Period."

Without sifting all of the facts it is very apparent to anyone with a modicum of reasoning and observation powers that, with all of our large expenditures for roads, streets, sewage disposal plants and various structures, some devoted to utility and other to art, has come better living and, undeniably, general increased prosperity.

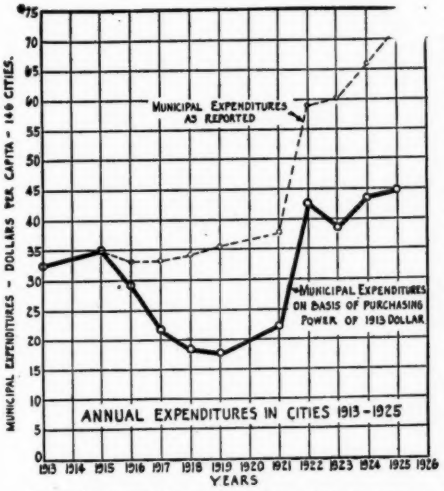
Increase in Municipal Expenditures Only Apparent.—The truth is that municipal expenditures only apparently have shown a considerable increase since 1913. Where they have actually increased investigation will show that the increase has been not only justified but inevitable to meet the needs of citizens. The population of cities has greatly increased in the last thirty years.

More than 40,000,000 people are now residents of cities. In fact, those cities which have populations of 30,000 or more house nearly one-third of the population of the United States. This increase has in itself created the need for many more functions of city government and the intensification of existing functions.

Our health officers must guard against the spread of disease in congested sections. Parks and museums must be provided for a vast number of people who can no longer find recreation in the country within an hour's ride. Adequate transportation and street lighting systems are necessary to carry on the city's business. The changes in the life of the individual have been as great.

Luxuries of 30 Years Ago Necessities Now.—Luxuries unthought of for general use 30 years ago are necessities in our homes today and in our cities. Gas, water, bathtubs, electric lights, steam heat and furnace heat, vacuum cleaners, gas ranges and automobiles are necessities. Where the city government is not called upon to supply these directly, it is demanded that the city provide for their use and enjoyment.

To mention a few more items which our fathers adopted only after long consideration and which are commonplace to this generation, are complete sewer systems and disposal plants, high pressure water supply, parks, public playgrounds, municipal golf courses, public bathing beaches, swimming pools and skating ponds, fireproof school buildings housing domestic science and manual training departments, street cleaning, complete snow removal immediately after a storm, municipal hospitals and sanitariums, large and intensified police and fire departments, public libraries, auditoriums, public comfort stations, municipal reference libraries, expert advisers in the larger cities (which save annually many thousands of dollars more than they cost, although only their cost appears in the budget); compensation and insurance for workmen employed on work conducted by city bureaus, etc.


MUNICIPAL EXPENDITURES - DOLLARS PER CAPITA - 146 CITIES.
MUNICIPAL EXPENDITURES AS REPORTED
MUNICIPAL EXPENDITURES ON BASIS OF PURCHASING POWER OF 1913 DOLLAR
ANNUAL EXPENDITURES IN CITIES 1913-1925
YEARS

Annual Expenditures in Cities, 1913 to 1926

The Effect of the Motor Vehicle.—Above all things the almost miraculous advent of 22 million motor vehicles upon our streets and highways in the last 20 years has greatly increased the services demanded of city government. They have necessitated new traffic police and mechanical systems of traffic control, public parking spaces, wider and stronger streets, new bridges, and many additional safety measures such as the abolition of railroad grade crossings. The modernizing of city departments is another necessary item in the budget.

Where once a $50,000 pile bridge had borne horse-drawn traffic, a $300,000 concrete structure is now required for fast moving 5 and 10-ton trucks. Pavements that met the needs of horse-drawn vehicles for nearly a century went into the discard almost overnight for smoother, stronger and more durable types devised to withstand continuous fast moving night and day motor traffic.

Now that virtually every family owns a car, hard surfaced paving is demanded on our streets. It is estimated that millions of dollars are spent without return, absolutely wasted, every year through delays and accidents in traffic that could be easily avoided by a much smaller expeniture in street and highway improvements. So much for the new demands brought upon our city.

The Trend of Municipal Expenditures.—What has been the trend of municipal expenditures during recent years? Are they mounting inordinately? Are they barely keeping pace with the new demand, or, are they nearly stationary with the old figures of 10 or 20 years ago? A city government is organized to render, under frequently changing administrations, a multiplicity of related and unrelated services for which no ledger shows a financial profit.

It is not to be expected that all the departments of the city government will operate as efficiently as an automobile factory. Honesty and reasonable efficiency we have a right to expect from public service. We know also that not every large private industry operates at the maximum efficiency. At least the percentage of failures would lead us to think so.

The U. S. Bureau of the Census receives detailed reports annually from all cities of over 30,000 population The number of such cities is, of course, increasing, but comparative statistics have been kept for 146 of them over a considerable number of years. The increase in the total expenditures will not be satisfactorily explained unless we consider the corresponding increase in the population of these cities. Therefore, the report lists also the average expenditure each year for each citizen.

The amount spent per capita in 1913 was $32.46. In 1923 this had risen to $68.99 per capita, apparently an increase of 112 per cent. To understand fully this increase, however, we must study the changes that occurred during the years between 1913 and 1925. In 1914 began a world war that lasted five years. Financial standards all over the

world were upset. The money of all European countries depreciated greatly and the currency of several of these countries is still worth much less than the pre-war standard. In the United States, our own dollar depreciated, until in 1920 it was worth less than half as much as in 1913.

The year 1913 is most frequently taken in government reports as representing the normal pre-war annual period. While the purchasing power of the dollar decreased, our cities had to function as usual even though in 1920 they would have had to spend twice as much to carry on the same amount of work and render the same service as in 1913; but the very real attempt to economize was noticeable, for the per capita expenditures in 1920 reported from these 146 cities was only $35.58. Improvements and even ordinary services were curtailed. Also during 1917, 1918 and 1919, public and private improvements were postponed in order to push the manufacture of ammunition and military supplies. In these years, too, the cities were spending very nearly the same amount per capita as in 1913 but actually purchasing in goods and services very much less.

To make a fair comparison the accompanying chart has been prepared showing by the broken line per capita expenditures reported for the population of these 146 cities since 1913. But to make a fair comparison of the work actually carried on by these cities, the per capita expenditures for each year have also been plotted on the basis of the normal dollar as we knew it in 1913. This curve shows very clearly the great drop in municipal activities during the war years and the increase after 1919 to catch up with needed improvements. Since 1919 private industry and family housing throughout the country also have had to spend large sums in order to make up for their own lack of progress during the war years. The average per capita expenditure from 1913 to 1925 is shown as $32 compared with the 1913 dollar.

Only Now Catching Up With Normal Expenditure.—In other words, we are only now catching up with the normal expenditure back in 1913. Or, to put it differently, we have spent virtually the same amount of money to operate our cities as if the war had not intervened and we had gone along steadily spending $32.68 a person each year to keep the cities functioning. There are now 247 cities of over 30,000 population, but the 146 cities with continuous records contain the majority of city residents and their consolidated reports fairly show the trend of city finances.

The Fluctuation of Net Indebtedness.—Another measure of the cities' activities is the fluctuation of the net indebtedness. The per capita net indebtedness in these 146 cities rose from $69.28 in 1913 to $119.45 in 1925. Here again we must take into account the variation in the purchasing power of the dollar. Even if one mile of new water main will serve the same number of homes as in 1913, it will cost very much more to lay this one mile, just as it costs much more to rent a home today. The debt curve shows the same reduction during the war years and again an increase as cities tried to catch up with delayed improvements and financed them by bond issues. Value for value, however, the average per capita debt during these twelve years is only $62.50, $6 less than in 1913.

The "Bond Buyer" shows that new issues of municipal bonds have been steadily decreasing since 1924. Cities have caught up with the improvements delayed during the war period and are back on a program of conservative expansion. Another evidence that civic debts are not extravagant is the high rating and ready sale of municipal bonds. Not subject to all of the federal and state taxes, municipal securities are in continual and increasing demand. Interest rates show how highly experienced bankers class municipal securities and the sound financial policy of the municipality which issues them.

Another chart might show the decrease in interest rates in municipal bonds. While high grade public utilities must finance their improvements with bonds paying 5 to 6 per cent, cities are able to borrow money at 4 per cent or less. Conservative bankers hold that, so long as the indebtedness is kept within 10 per cent of the total assessment, spreading the cost of public improvement over several years at a low rate of interest, is sound policy. Many states place the limit of debts which cities may contract at much less than 10 per cent.

"History Repeats Itself."—History repeats itself and it is interesting at this time to reproduce a few excerpts from a speech made by D. C. Westenhaver before the West Virginia Bar Association about 1895:

"The simple truth is—and herein lies the chief fact of the whole subject—that this increase of indebtedness and in the rate of taxation is not due in the main, or even in the large part to jobbery or corruption or wasteful extravagance, but is due to an extension of the sphere of governmental activity, calling for larger revenues which our antiquated system of state and local taxation are inadequate to produce. I repeat, governments as now organized, are expected, nay, compelled by the wishes of the people, to assume new functions and undertake new duties. The industrial development, or the genius of the age, or what is the same thing, the prevailing belief of thinking people, has set new tasks for governments, which they must assume and perform, and which in this era of democratic self-government, cannot be shirked!

". . . By these means the world has been made a much better place to live in. Man has increased in mental, moral and physical stature. . . . The sum total as well as the average distribution of these things which go to make life comfortable have increased. . . . There is a sound reason why debts and tax rates have increased . . . and that increase of expenditure is not only unavoidable, even if undesirable, but that it is going to continue. This tendency is world-wide."

Ponder for a moment the fact that these words were spoken before the advent of the automobile, before cities had sufficient sewerage systems, before electricity replaced the kerosene lamp, before we had countless other improvements undreamed of 30 years ago.

Occasional careless statements alleging that public expenditures should be cut to the bone because taxes have risen and bond issues increased should not bind us to an intelligent consideration of the facts. Our real aim should be efficient and economical expenditure of public funds.

A large expenditure is thoroughly justified if it brings sufficient return in increased safety, efficiency or comfort to the citizens. Most of these large expenditures really pay for themselves many times over in actual financial benefit to residents of a city. As expressed by Blaine F. Moore of the finance department of the Chamber of Commerce of the United States, "Sane spending is intelligent economy."

Let us attempt to get full value for every dollar spent and not lay the faults of the few cities where graft and inefficiency predominate against those thousands of other cities which are progressing steadily, conservatively and economically in step with our ever improving standards of health, safety, comfort and sane living.

Reports on Sewage Plant Operation.—Operators of sewage treatment plants in New Jersey submit monthly reports to the State Department of Health. The reports are made up from the daily records kept at the plants of daily sewage flow, the volume and nature of the materials removed from the grit chambers and screens, readings from Imhoff tanks, the amount of liquid chlorine or other disinfectant used each day, amount of sludge removed from the sludge beds, etc. All unusual conditions are also noted.

Yellow As Protective Color for Hydrants.—All of the hydrants received their usual painting, packing, and testing. Since the yellow color scheme was adopted we have not had a broken hydrant by an automobile. It is very apparent that yellow paint is good insurance. R. W. Esty, superintendent of Water Works in 1926. Report of Water Commissioner of Danvers, Mass.

Managerial Functions of a Manager

What the City Manager Finds Out His Duties Are Described in The City Manager Magazine

By JOHN N. EDY
City Manager, Berkeley, California

To the end that men may live well, the objective of a city government is, first, the effectual maintenance of public peace, health, and morals; second, the efficient prosecution of those public services and activities which reflect intelligent local opinion as to the demands of public welfare.

Let us turn now to the practical aspects of the question and ascertain, if we can, the practical objective of the manager plan.

The American City Magazine is publising a number of letters under the title, "How the Manager Plan Is Working." Thirty of these letters written by responsible officers of commercial and business organizations in city manager cities, have been published. I take it they reflect the business viewpoint. I was interested but not astonished to find, upon analyzing the statements, that the accomplishments or attributes of the city manager plan that merited approval of and special comment by the several correspondents are as follows:

(1) The elimination of politics; 17 cities.
(2) Increased efficiency of employees; 17 cities.
(3) Economy of expenditures; 16 cities.
(4) More miles of pavement; 15 cities.
(5) Centralized administrative control; 9 cities.
(6) Reduction of tax rate; 9 cities.

The Objective.—If the experience of these thirty cities and the reaction of these thirty business men are typical, and I believe they are, we may re-state our objective in practical terms as follows:

To eliminate politics, increase efficiency of performance and introduce economies of administration so that an approved program of public service and improvements may be presented at a reasonable cost.

The local interpretation of these two definitions—the one ideal or theoretical, the other intensely practical—is found in the budget and work program of every modern progressive city. With proper allowance for difference in city charters, and referring to just those activities with which the city manager is usually concerned, we may say that the administrative or executive business of a city includes:

(1) Law enforcement.
(2) Finance.
(3) Ordinary work program.
(4) Administrative policy and organization.
(5) Personnel supervision.
(6) General supervision.

These divisions of the city manager's work are too well known by you to require amplification; but I should like to touch briefly on four of them.

Law Enforcement.—Law enforcement does not usually, I think, require a great deal of the personal time of the manager, although under certain conditions it may. The significant point as I view it, however, is that when the city manager is designated by charter as the chief law enforcement officer of the city, he must give to the people his personal guarantee that the laws will be enforced, and also that they will be rigidly observed by every municipal employee including himself.

Financial matters generally constitute the most exacting claim upon the city manager, who, in my opinion, is essentially a finance officer. The budget must be his personal effort when he lets go of it; budgetary control must be constantly and personally supervised; the purchasing policy must be his policy.

You will note that in outlining the six subdivisions of administrative effort I included the ordinary work program. That was deliberate because I believe that, except only in the field of public safety, the city manager should not promote or attempt to initiate extraordinary improvements. The introduction of economies and proposals for betterments in connection with prevailing essential services, enterprises or functions fall well within his sphere; but it is my conviction that the active promotion of so-called comprehensive programs is almost certain to lead to his embarrassment.

Some Questions.—I had occasion about two months ago to address a group of citizens in Berkeley, the Berkeley Realty Board, made up of fine, high-class, intelligent citizens, all good citizens, I am sure, and they are keen. If you don't think so, just try to buy something from them at a price at which you think it should be sold. In order to introduce just a little novelty into the program, I prepared a questionnaire. This questionnaire asked a number of questions. Among them were: What prevailing function or service of the city government, in your opinion, should be abandoned? What prevailing function or service of the city government, in your opinion, is receiving too much emphasis? What function or service not now being performed by the city government do you think should be added to the municipal program? Then I asked, "What public improvement do you suggest for the city of Berkeley?"

I asked for some constructive suggestions, leaving the field wide open. The questionnaires were distributed during the luncheon and were gathered. While I was speaking, one of the men from the office put a dollar sign before all the suggestions.

In ten minutes, this bunch of good citizens who are awake to the possibilities of the community in which they live spent a million and a half dollars of the city's money, and increased our tax rate just exactly 100 per cent.

I bring that out, because I am sure it is the experience of all of you that a city manager can very often render his best service in blue-penciling a lot of the things proposed. He can, of course, use his judgment and discretion in singling out from many proposals the things which are within the possibility of the financial program of the community.

My last suggestion on these divisions of administrative effort relates to the matter of administrative policy, and is this: The city manager must himself establish the standard of service and performance to be rendered by the departments subordinate to him.

What Constitutes Management?—Here again I am on ground familiar to you all. But I want to suggest a statement of the elements of management that has always appealed to me.

The elements of management are: analysis, planning and financing, organization, personnel administration, supervision. You observe how simple and orderly this definition is, and how it fits into the job of the city manager.

How Does He Manage?—We could stay here all day answering that question. And because I think the subject worthy of serious consideration; because I desire to capitalize my own experiences, I shall conclude with a statement of eleven rules, the observance of which has proved personally helpful. You will add to or combine them as your experience dictates; and I reserve the right to do likewise as the years bring me new vision.

I have as Rule one the rule of definite understanding between city council, city manager, the chief officials, or department heads, and employees, as to where administration begins as far as the council is concerned and where legislation leaves off, where the immediate supervision of the city manager will begin and end and where the department heads will take up the burden and

carry it, what the contracts are likely to be between the city manager and department heads and employees, the duties of all concerned in the big project. If that thing can be analyzed and put down on paper, even scratch paper, and set aside in the desk of the city manager and if everybody can understand it, I think the enterprise will get under way with much less danger of friction.

In my own case, the first thing I did was to gather around the table with the council and find out how they interpreted the obligation of the city manager. We didn't agree on some of our interpretations, but we thrashed them out and settled them, and not once since that time has the question been raised as to whether a certain matter was legislative or administrative.

Competent Assistants.—The second rule is the rule of competent assistants. Those of us who have had some business or public service experience, whether it be as city manager or not, know it is useless to attempt substantial accomplishment with assistants who are not competent.

My thought in that connection is that while we want the most competent and best trained judgment we can get as city managers, we can never permit the expert judgment to spend the public's money. There is not enough money in the whole San Francisco Bay region to finance the public services there would be if the trained and competent department heads in the city of Berkeley were permitted to exhaust all the possibilities of those public services.

Adequate Equipment.—The third rule, thinking again of the city manager as an individual, is the rule of adequate equipment. I think it must be established definitely that before a man starts to work he must have proper equipment in the way of office quarters, in the way of transportation, communication, and whatever service is needed for him to work in a wholesome way and to concentrate thoroughly. I know of some city managers in California who are not equipped to do a job that is represented by a city with the dignity with which it should be done.

Rule four is that of delegation of work and written instructions, which prompts me to say that which you all know, namely, in prosecuting his program the city manager must, of course, accept work from someone else which is not up to the standard which he would like or not up to the value of the work which he himself would have turned out had he had the time to do it.

Rule five is the rule of uniform procedure, the idea being the use of printed forms, regular reports, pre-determined flow of business. Everything which can very well be made a routine matter leaves just that much more time for the new items of business that claim the city manager's attention.

Rule six is the policy of follow-ups, what we are going to single out of all the artificialities with which we are surrounded in order to make a job of municipal management. If I were to single out the things of most value in accomplishing things, I would single out that policy or rule of definitely following up everything that is started. It is my opinion and my practice that nothing that passes over the city manager's desk at any time should ever be forgotten or lost until it is finished. That does not mean the city manager must do it himself. It does mean, however, it must be somebody's job to do it.

Accessibility.—The next rule, number seven, is the rule of accessibility to the public and employees. We all have the open door policy of meeting the public not at any time between eight and five, but at certain times when people can come to the office of the city manager. In general, however, I think we are sometimes prone to forget (I am not going to say this is a fact; I am stating it as my opinion) that the first obligation of the city manager is to maintain prevailing functions and prevailing services. That means even at a considerable inconvenience to himself, at a considerable disadvantage to himself. He must make way for appointments with chief officials or department heads when the whole work of the organization depends on that contact with that department wants to effect.

The eighth rule is administrative responsibility, and by that I mean, again, that which is familiar to all of you. In the final analysis, try as hard as you will to avoid it, the time comes when the city manager himself must assume responsibility or must clean up a mess, decide a question or do a piece of business that perhaps one other person or perhaps half a dozen other people ought to have done but who have not done it. It is not an answer to the question to explain, of course, to the public that this is a police job, a street job, a park job. The public is interested in having it done, and if that involves a considerable expenditure of time in going into detail, which is not at all to the liking of the city manager, of course, that must be done.

I have always been interested in reading those stories about the business executive which give you to understand that a man in charge of the administration of any project must never permit himself to be engrossed in detail. I have never seen a man, and I have endeavored to meet many men successful in business, who would not admit that at some time it was necessary for him to get down and find out what was at the bottom of the very difficulty facing him.

Impersonal Interest.—My ninth suggestion is that of impersonal interest. I think it should be axiomatic that a city manager would have no personal interest in anything that happens in the community in the way of official occurrences. If he can maintain that impersonal attitude, he will very often avoid controversy and personal issue.

There are only two more of these so-called rules that I am suggesting now, merely to have them in shape to talk about if we care to. The tenth is the rule of administrative example and right conduct.

The eleventh rule is that of constant vigilance, which is merely another way of saying that the city manager's job is never done, that he can never be absolutely sure that everybody is going to do everything expected of him.

Right Conduct.—Now, in regard to the tenth rule, administrative example and right conduct, it should not be necessary, of course, to suggest to a group of city managers that the example they set in the way of industry, in the way of punctuality, is very likely to be picked up and followed by everyone in the organization. I think if the city manager expects the employees and department heads to respect authority he must, in turn, respect the authority of those superior to him. If he expects the employees and department heads to spend a considerable part of their own free time along the direction of self-improvement he must show he is also doing everything he can to improve himself and render himself more able to do a high-class job of management. In other words, if the city manager himself exemplifies that which he demands of all his employees, a clean municipal service in the way of fairness and good contact, the chances are ten to one it will be easier for him to secure from these employees the degree of service that he is expecting.

Discussion

By George Garrett, Grand Junction, Colorado

This is a very broad subject and Mr. Edy has covered it very well. I have made note of the principal points he brought out in his paper, and I find that he has classified his principal statements under eleven different heads.

Definite Understanding.—Now, that would mean a definite understanding, not only of your duties and responsibilities as a city manager, but a definite understanding by the city manager and the members of the city council of the municipal policies, formulated primarily by the city council, and a definite understanding by all municipal officers and employees of the policies laid down by the city manager for the conduct of all municipal activities.

I have had five years' experience as a city manager and some ten years' experience as a municipal official and employee previous to that—eight of which were spent in the employ of the city of Portland, Oregon. During that time I have served under several councils and commissions.

Speaking from these years of experience, I would say that it is very important that the city manager have a definite understanding of the municipal

policies under which he is to administer the affairs of the city. However, it has been my experience that a city council does not, at the beginning of its term of office at least, lay down a definite set of rules and regulations or a set of policies for the city manager to follow. Consequently, I think it behooves the manager to become thoroughly acquainted with the members of his council as soon as possible after assuming his position, in order that he may determine, in his own mind, the policies that they would like to have him follow.

Competent Assistants.—It goes without saying that we should have competent assistants. But to have competent assistants we must pay reasonable salaries and wages. In the larger cities, you can pay good salaries and can secure, we might say, experts to take charge of the various departments. In the smaller cities where it is usually necessary to pay small salaries, the city manager will have to develop his chiefs of departments from local men available. Unless he himself has had a very comprehensive experience in municipal affairs and can personally supervise the work of a department, until such time as his newly appointed chief can be sufficiently trained to assume full control, he will be greatly handicapped.

Adequate Equipment.—In order to secure the best results you must have adequate equipment as well as efficient and competent operators. Adequate equipment means the employment of sufficient equipment to accomplish a specific purpose. I would add that we should be very conservative in our selection and purchase of equipment to the end that we shall employ only such equipment for the various purposes and by the various departments as will secure the best possible results at the least possible cost.

I remember, shortly after I assumed the position of city manager at Grand Junction, Colorado, I was informed that the main criticism of the previous administration which operated under the commission form of government, was that they had spent annually large sums of money for the maintenance of the city streets but had produced no tangible results to show for the money spent. I found the equipment on hand for maintaining the streets was old and worn out. By making extensive repairs to the old equipment and the purchase of considerable new equipment, we were enabled, during the three-year period, to secure excellent results at a 20 per cent reduction in operating costs.

Delegation of Work and Written Instructions.—If the manager has a loyal well-trained and efficient organization he will be enabled to delegate practically all detail work to his subordinates and will thereby avail himself of more time in which to inspect the work being performed by the various departments and forces, and in which to solve the larger problems confronting the administration, and in which to make plans for future work and improvements.

The manager of the larger cities, on account of being enabled to employ more highly trained subordinates, will be enabled to shift practically all detail work. But the manager of the small city, on account of the lack of such subordinates, will have to perform more or less detail work. It is for this reason that I say the manager of the small city has the hardest job and consequently should have had a broader and more varied experience in municipal affairs in order to be successful in his work.

In my mind, it is very important that the city manager issue his instructions to the chiefs of departments in writing, thus avoiding all misunderstandings of instructions. He should use a follow-up system in which to file copies of such instructions to insure their execution in proper time.

Uniform Procedure.—I believe every city manager should adopt rules of uniform procedure for performing the routine duties of each and every department, and then insist that such rules be consistently followed at all times. However the managers should always be receptive to suggestions from the chiefs of departments for improvement to such rules or methods.

Follow-up.—"Follow-up" is the system by which we are enabled to ascertain readily the present status of any project or endeavor from its inception to its completion. By the use of follow-up systems, as well as progress reports and charts, the city manager is enabled to keep fully informed as to the present status of all municipal activities, and is enabled to say to an inquiring citizen, "Such is the present status of this project," instead of saying "I will find out and let you know later." The use of a follow-up system in handling complaints from citizens I have found to be quite effective in eliminating criticism.

Accessibility.—Your success as a city manager depends to a great extent upon the degree of your accessibility to the public and your subordinates. To afford the greatest degree of accessibility to the public, the city manager should be very brief though courteous in his interviews with the citizens who call to see him at his office during business hours, thereby enabling him to interview the greatest number in the time allotted for such interviews and to conserve not only his own time, but the time of the citizens.

In order to do this he must be very tactful in his methods, have a thorough knowledge of municipal affairs and local conditions, know the present status of all municipal activities, and be able to render quick decisions. He should also have the courage to say "no" and to stand by his decisions. He should not make promises which he knows he cannot fulfill, just as a means of getting rid of persistent citizens. He should also be impartial in his decisions, treating all citizens alike, regardless of their political or religious affiliations or their social standing.

Likewise the manager should be accessible to his immediate subordinates at all times, instructing them to use the phone to present urgent matters for his consideration and decision in case he is engaged in an interview.

During the time from May 17th to November 6th of this year I traveled some 11,000 miles in my automobile, having traversed the territory between Grand Junction, Colorado, and Los Angeles, California, the Pacific Coast from Mexico to Vancouver, Canada, and the territory from Astoria, Oregon, to Cleveland, Ohio. During this extensive tour, I had the pleasure of visiting many city managers and of investigating municipal affairs in many of the principal cities along the way.

An Illustration.—I had the pleasure, on several occasions, of sitting in a city manager's office for some considerable time before being granted the favor of an interview with his "royal highness." It seemed to me that every caller who preceded me had very important and extensive business to discuss with the manager, judging from the length of time they were in his office. Such may have been the case, but I doubted it very much. I had plenty of time at my disposal, so I usually waited, but I noted that several persons, after having waited for quite a while, decided that it was a "long time between interviews," and then left the reception or "waiting room" with a look of disgust on their faces. Now evidently, the said managers believed that they were pursuing the right policy by visiting with each caller as long as they desired to visit with him. But to my mind, they were making a grievous mistake. I believe that brief, though courteous interviews, which allows the manager to see more people in the same length of time, and allows him to spend more time in the supervision of the various municipal activities. Make the manager more accessible to the public and we'll cause less criticism than long interviews and glad-hand receptions.

In several of the larger cities I visited, and where I had to wait but a very short time before being granted an interview with the city manager, I noted that a special clerk was stationed at a desk near the main entrance to the city hall with the sign "Information" in large letters on the desk, and in one instance an additional sign stating "Register all complaints here" was in evidence. This service is a great aid in conserving the manager's time.

The average citizen when he has a complaint to make seems to think that he should make it to the city manager directly. But the majority of them would not attempt to see the manager personally if confronted by such signs before reaching the manager's office. Their complaints are recorded, or else they, the citizens, are referred to the proper departments and receive cour-

teous treatment. Of course, if they have previously made a complaint, and its cause has not been removed, they will want to take the matter up with the city manager personally and will be justified in so doing.

Administrative Responsibility—I believe the following two statements from the City Managers' Code of Ethics set forth fully the administrative responsibility of the city manager.

"Although the city manager is the hired employee of the council, he is hired for a purpose—to exercise his own judgment as an executive in accomplishing the policies formulated by the council and, to attain success in his employment, he must decline to submit to dictation in matters for which the responsibility is solely his."

"Power justifies responsibility, and responsibility demands power, and a city manager who becomes impotent to inspire support should resign."

If a city manager is to make a success of his administration, he must necessarily have power requisite to his responsibility. He should not shirk responsibility but should welcome it.

He should not submit to dictation from the council or its individual members relative to the employment or discharge of his subordinates. Nor should he permit such dictation to his subordinates, relative to such matters, the methods of performing their duties, or of the performance of any special work.

During my trip last summer, I met three managers who seemed to try to shift as much responsibility as possible to their city council. I believe the council, in the first place, may have been somewhat to blame for this tendency on the part of the city manager, as they had appointed separate Boards to administer the affairs of different functions of the city's affairs instead of delegating such function to the city manager for his supervision.

In one city where they had just taken over a water system from a private corporation, the manager had advised the city council to appoint a Water Board to administer its affairs. It may be that the real reason for this manager's recommendation was that he had had no previous experience in the operation of a water plant. However, to my mind, such action on the part of the manager was absolutely wrong. I believe that a city manager should be qualified to supervise the work of all departments of the city's service and when he is hired with that understanding he should not shirk his responsibility. The ninth subject was "Improved Interest." "The city manager is the administrator for all the people, and in performing his duty should serve without discrimination." In other words he should have no personal interest in any particular section of the city or in any "clique" or organization as relating to municipal affairs.

No doubt it is very difficult for the "local man," who is appointed manager of his city to maintain an impersonal interest in the city's affairs. It is hard to refuse a favor to an old friend even though you know it is not good policy to grant it. However, if the manager is firm in his stand on his policy of impartial treatment to all citizens, he will retain the friendship of his sincere friends and the respect of the vast majority of the citizens.

"A city manager will be known by his works, many of which may outlast him, and regardless of personal popularity or unpopularity, he should not curry favor or temporize but should in a far-sighted way aim to benefit the community of today and of posterity."

Law Enforcement.—There is no question in my mind as to the advisability of the city manager setting an example for the observance of the laws and ordinances of the city. If he does not do so it will not be long before the members of his police force become lax in the enforcement of such laws and ordinances as the manager does not observe. Therefore, the manager should not expect to have laws enforced on others which he does not observe himself.

During my extensive tour this year I was not arrested once and was only stopped on two occasions by traffic officers for having violated minor traffic regulations. I tried to observe the traffic regulations of the various cities which I visited, but as such regulations varied in the various cities, it was no easy task.

However, in driving on the county or state highways, where the speed limit was thirty-five miles per hour, I noticed that most cars traveled at the rate of forty-five miles per hour, especially in the sparsely settled districts. When I first started out on my tour, I tried to observe the thirty-five mile limit, but after permitting a good many other cars to pass me while I was traveling at that rate, I decided to follow the prevailing custom and thereafter traveled considerably faster.

I believe it is not the strict letter of the law, but custom which governs the actions of most people, most of the time. Some of our laws and ordinances may be archaic and impractical and we do not attempt to enforce them. However, I believe such laws and ordinances should be repealed, and only such laws and ordinances adopted as are sane and practical of enforcement.

As I stated in one of the first public meetings I attended in Grand Junction, "If the city manager attempted to enforce all of the ordinances on the city books, he would soon be given a ride out of town on a rail." I believe we should use our judgment in what ordinances we enforce until such time as we can have the archaic and impractical ones repealed or amended.

Considering another phase of this subject, I might state that I believe the city manager has no right to expect his subordinates to be courteous to the public, dignified in their conduct or efficient and interested in their work unless he, himself, sets the example.

Constant Vigilance.—Some of the city managers present, who have had quite a little trouble with certain members of their city council or with politicians in their respective cities, know exactly what that means, in one sense of the word at least. That you must be constantly on the alert, being prepared to give satisfactory explanations of past actions and proposed plans for future action. You should have data on all phases of municipal activities readily available for use when called upon to make such explanations.

Constant vigilance, to my mind, means that the city manager is on the job all of the time, that he is constantly investigating the methods used and results obtained by the various departments, the progress of all public improvements, and while so doing is considering plans for improvements in such methods and work.

High Head Pumping on Paving Job

The necessity of securing water for the Mountain Springs paving job in San Diego County, according to June California Highway News, probably resulted in the establishment of a new record for the highest head encountered on any paving project in California.

It was necessary to secure water at Jacumba and to pump it over a summit 44 miles east, from which point it flowed by gravity to the work. The difference in elevation between Jacumba and the Summit Reservoir was about 417 feet. The amount of water required was estimated at 300 gal. per minute. The total elevation between the summit and the lowest point to which the water was carried for use was 1,753 ft.

The pumping to the summit was accomplished by means of a 2½ in. six-stage type MMB horizontal centrifugal pump with bronze impellers. The pump was operated by a 5⅜ in. by 6¼ in., 4-cylinder Waukesha industrial power unit with twin disc clutch power take-off. A 4 in. welded steel line was used to convey the water to the summit and this line crossed the highway 2-3 mile east of the pumping station, with two 45 degree angles.

In order to insure full discharge, a booster pump was located 2.6 miles from the first pump. This was a 4½ by 5½ Triplex pump, also driven by a Waukesha motor. The piping was so arranged, that the water could be passed through the pump or by-passed around it, which made it possible to operate either only the first pump or use both pumps at the same time.

New Type Disposal Plant

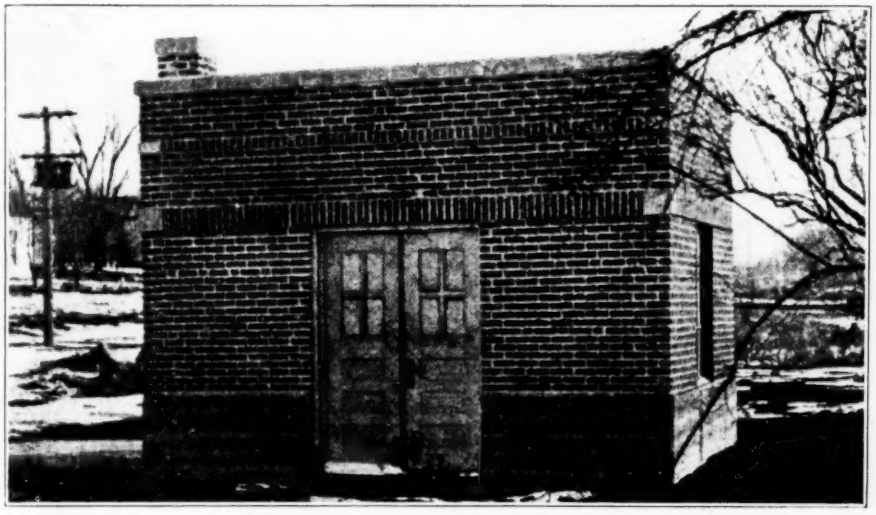
New Sewage Treatment Works at Winterset, Iowa, Described in American Municipalities

By T. R. HASELTINE

Assistant Engineer, Burns & McDonnell Engineering Co., Kansas City, Mo.

Winterset is the county seat of Madison County, Iowa. It has a population of about 3,000. In 1925 it was the largest city in Iowa without sanitary sewers. It was felt that this condition endangered its health and future prosperity. To remedy this situation the City called in the Burns & McDonnell Engineering Company of Kansas City, Mo., to design a complete sewerage system and sewage disposal plant.

Plant Site.—Winterset is situated on the water shed between Middle River and Cedar Creek so the entire city could not be served by gravity to any single disposal plant. Any disposal plant on Cedar Creek would have to give very complete purification as the stream is dry during the summer months. It was found that one large plant on Middle River and a pumping station in the city to pump the sewage from the north part of town into the outfall main could be built and operated cheaper than could two smaller plants, one of Middle River and one on Cedar Creek. The plant site selected was about a mile southeast of the city limits and near Middle River. The site was about a thousand feet down stream from the city park.



Sewage Pumping Station

Type of Disposal Plant.—The primary object of a sewage disposal plant is to prevent nuisances. Local conditions determined the type of sewage to be treated and the degree of purification required. The sewage at Winterset is a typical domestic sewage. The proper treatment for this kind of sewage, when final disposal is made to a stream of slight continuous flow, consists of sedimentation for removing the heavier solids, accompanied by coarse screening for removing the larger suspended and floating solids, and secondary treatment by stone filters for imparting the necessary amount of oxygen to the effluent for stability. Putrefaction does not occur while available oxygen exists in a sewage.

In the past sedimentation has been accomplished in either septic or Imhoff tanks in neither of which is the digestion of the settled solids or sludge entirely separated from the incoming raw sewage. A more recent method of accomplishing the same results is used in the separate sludge digestion plants where two independent tanks are used, one for sedimentation of the raw sewage and one for sludge digestion. The sludge from these plants, like that from Imhoff tanks, is inoffensive and easily dried. Inasmuch as the sludge digestion is entirely separated from the sedimentation there is no danger of the digestion process depleting the oxygen content of the raw sewage or causing gas formation that would interfere with proper sedimentation.

Capacity of Plant.—As previously stated the present population of Winterset is 3,000 but it was thought best to design the plant for a future population of 4,000.

The estimated average flow was 60 gallons per capita per day, consequently the plant was designed for an average daily flow of 240,000 gallons. The pumping station was designed to care for 90,000 gallons of unscreened sewage per day.

Clarifier and Screens.—The incoming raw sewage first passes through the screen chamber, the openings in the screen being one inch wide. Under normal conditions the sewage flows from the screen chamber to the clarifier, but it may be by-passed to the river if desired. The clarifier is a concrete tank twenty-five feet square and approximately eight feet deep. This affords a detention period of 2.8 hours. The bottom of this tank slopes to a central cone. A mechanical squeegee is supported from a truss over the top of this tank. The squeegee consists of four radial arms on which plows are set at an angle. Two of the arms have extensions on them that sweep the corners of the tank. The motor and driving equipment for this mechanism is housed in a stucco house supported on the truss over the center of the clarifier.

The incoming sewage flows into an influent trough at one side of the tank and thence through five ports into the clarifier tank. The sewage flows horizontally over the entire area of the tank and overflows a weir into a collecting trough on the opposite side of the tank. The solids settle to the bottom of the tank and are swept to the central collecting cone by means of the mechanical squeegee. This mechanism revolves continuously but very slowly so as not to disturb sedimentation. It is simple and rugged; it makes only one revolution every seven minutes so the wear is negligible.

The sludge is to be pumped daily from the clarifier into the digester. An electrically operated diaphragm pump is provided for this purpose. It is expected that all sludge that will collect in a day can be pumped into the digester in an hour's time.

Digester.—The digester is a concrete cylindrical tank thirty feet indiameter and approximately fifteen feet deep. This gives a sludge storage capacity of more than 2.6 cu. ft. per inhabitant for the designing population of 4,000.

Sludge digestion is a bacterial process and it has been learned that the digestion of fresh sludge is hastened if it can be mixed with partially digested sludge in which the particular bacteria causing digestion are abundant. For this reason, the digester is equipped with a mechanical stirrer. This mechanism is suspended from a steel truss across the top of the tank. There are radial troughs on the mechanism near

the top of the tank into which the incoming sludge is deposited. As the mechanism revolves these troughs distribute the sludge over the entire surface of the tank. There are also radial arms near the bottom of the tank that aid in stirring. The action of the mechanism reduces the screen formation to a minimum.

The sludge is drawn out at the bottom of the tank from a central cone through a pipe onto the sludge drying beds. When it is desired to draw off sludge from the digester the digester mechanism is started. The lower arms on this mechanism force the digested sludge from near the sides of the tank to the central cone where it passes out.

The digester mechanism is only operated while fresh sludge is being pumped into the digester or while digested sludge is being withdrawn. It makes one revolution every seven minutes.

Sludge Digester and Clarifier

Sludge Drying Bed.—The sludge drying bed is forty-five feet by thirty feet with a central partition wall dividing it into two sections. This provides one square foot of sludge drying surface for each three inhabitants. The sludge may be deposited by gravity on either or both sections of the bed as desired. The bed consists of a six inch layer of sand over a layer of gravel. There are concrete walls around the bed to prevent clay from working into the bed. The underdrainage system consists of drain tile laid with open joints under and surrounded by gravel.

Trickling Filter.—The effluent from the clarifier may be by-passed to the river if for any reason the filter is not operating, but under ordinary conditions, it flows to the dosing tank which contains a syphon which discharges the sewage intermittently onto the filter. The trickling filter consists of a rectangular concrete tank about sixty by one hundred feet. This tank is filled with crushed quartzite stone to an average depth of seven feet four inches. This provides for a dosing rate of approximately 250,000 gallons per day per acre per foot of depth. The incoming sewage is sprayed into the air, where it absorbs oxygen, through nozzles; it then falls back on the filter where it trickles through the crushed quartzite. It is then collected in the under drainage system and flows out of the filter into the effluent line and thence to the river. Ample provision has been made for ventilation of the filter through the under drainage system.

Advantages.—While this is the first sewage disposal plant of this type to be built in Iowa, this type of plant has been used very successfully at large and numerous small cities in other states. It has several advantages over an Imhoff tank. Small cities have a great deal of trouble in getting competent and constant attendance of Imhoff tanks because the work is very disagreeable. The separate sludge digestion plant does not need constant attention. Daily inspection visits are all that are required. The disagreeable work is all done by machinery; the attendant need only start and stop the sludge pump and digester mechanism and oil the machinery. It is always desirable to have water under pressure at a sewage disposal plant for use in cleaning and flushing piping. Many small plants are built without this advantage because power is not available. With separate sludge digestion plants, power is available and a wash water pump may be installed. At Winterset a 100 gallon per minute at 70 foot head centrifugal pump was installed. This pump takes water from the supernatant liquid in the clarifier. The cost of electrical power for the plant when operating at full capacity will be $1.10 per day.

This plant was designed and built under the supervision of Burns & McDonnell Engineering Company of Kansas City, Mo., and Los Angeles, California. Repass Brothers of Des Moines, Iowa, were the general contractors and the mechanical equipment was furnished by the Dorr Company of New York. The cost of the plant was approximately $38,300.00.

Public Water Supplies in Maryland.—According to the 1926 report of the Bureau of Sanitary Engineering of the Maryland State Department of Health, the percentage of population using public water supplies increased from 62 in 1916 to 71.6 per cent in 1926. The number of treated water supplies increased and the per cent of the total population of the State using these supplies increased from 54.9 to 66.3.

New Melting Pot with Small Capacity

A new electric melting pot has been introduced for melting solder, lead, babbitt, tin, etc., which has a capacity of from 27 to 40 lbs., according to the metal to be melted. This pot may be operated on either 110- or 220-volt alternating or direct current circuits and is made in two ratings, 750 and 1,000 watts.

The new pot is a General Electric product and is the smallest size of the G. E., RP form E line. It consists of a durable sheet steel cylindrical casing 10 in. deep and 9 in. in diameter, in which is supported a cast iron crucible 4 in. deep and 6 in. in diameter, inside. The space between the crucible is efficiently insulated with a compact heat insulator.

Heating units are of the cast-in, sheath-wire type so successfully applied to metal melting. One unit is used in each pot, dissipating 750 watts in one rating, and 1,000 watts in the other.

The leads of the unit are brought over the top of the pot into a connection box fixed to the unit itself.

The new pot is designed for melting lead, babbitt, tin, solder and similar alloys or metals, except spelter or zinc, at temperatures not exceeding 950° F. Detailed capacities follow: for 50/50 solder, 30 lb.; for lead, 40 lb.; for babbitt, 37 lbs., and for tin, 27 lb. The approximate shipping weight is 50 lbs.

New Book

Municipal and Rural Sanitation, by Victor M. Ehlers, C. E., and Ernest W. Steel, C. E.; McGraw-Hill Book Company, Inc., 370 Seventh Avenue, New York City, publishers; First Edition, 448 pp., Illust., Cloth.

This new and worth while addition to the line of technical books available to sanitary engineers covers very well the various topics applying to the field intimated by the title. The authors are engineers of experience and reputation. Mr. Ehlers is Chief Sanitary Engineer of the State Health Department of Texas, while Mr. Steel is Professor of Municipal and Sanitary Engineering, Agricultural and Mechanical College of Texas. Their book deals with communicable deseases, excreta disposal, protection and treatment of water supplies, refuse collection and disposal, control of mosquitoes and other insects, rodent control, milk sanitation, food sanitation, plumbing, ventilation, light, housing, school sanitation, industrial hygene, tourist camps, swimming pool sanitation, disinfection, vital statistics, public health organizations, and a number of other interesting and important topics. Informative appendices present added information. The topics are treated in a clear, concise manner, yet as exhaustively as seems possible in a book of this size and scope. Methods and protective measures are based upon current good practice, and this book therefore appears to possess merit as a text that should prove very useful.

Can We Solve the Traffic Problem by Guesswork?

A Statement of the Many Factors Influencing Traffic Control and the Methods That Must Be Adopted by a Municipality

By MILLER McCLINTOCK

Director, Albert Russell Erskine Bureau of Street Traffic Research, Harvard University

Five years ago people were confidently predicting that the saturation point for the automobile in America would be somewhere around eighteen to twenty million automobiles. We now have twenty-three million automobiles operating over the streets and highways of American cities, and within the lives of most of us, probably by 1950, there will be forty million automobiles on the streets and highways of America, almost twice as many as we have at the present time. Furthermore not only is automobile registration in urban centers increasing very rapidly, but also the population of these urban centers, and likewise the population in the centers of our cities is still increasing at a very rapid rate. All this means that those potential causes of accidents and congestion which have caused so much difficulty up to the present time are not through functioning.

Be assured then it is time we gave to the problem of traffic everywhere intelligent thought. And, of course, that means that we must drop our guessing and get down to facts. We must drop our prejudices and be willing to re-adjust ourselves to conditions which are so greatly altered in the last four or five years, and which in the next four or five years will perhaps alter even to a greater degree.

Get the Facts First.—In any large city the traffic problem has become entirely too large for any one person even to begin to visualize. It has been my very great privilege of studying intimately during the past year the traffic problem of the nation's second largest city, Chicago. When I went to Chicago fourteen months ago, I thought I knew a great deal more about the city than I am positive I do not know today. When you get a city with three million people circulating about in the form of traffic every day, you have a complex mass of humanity, with such infinite numbers of potential complications, resulting both in accidents and in congestion, that it is almost impossible to visualize the situation, to say nothing of guessing about it with any degree of intelligence. I think you may be interested because Chicago is typical—perhaps a little enlarged over your problems, but typical of the traffic problems that arise in American cities.

We found, for example, that of those three million people who make up the inhabitants of that city, 850,000 of them daily move from their homes on a journey averaging four and one-half miles down to the Loop district, a central business district less than one mile square. In other words, in a square mile you have an office or business population, day-time population, of nearly a million people. And that I have found from surveys over the country to be a typical percentage. Somewhere between 25 and 33 per cent of the population finds it necessary, in order to buy its commodities or transact its business, to go from homes to the central business district.

Now if you will visualize the great inrush of a million people in the morning, between eight o'clock and ten o'clock, and a similar out-rush of people at night, between four o'clock and six o'clock, and then visualize all this million of people riding about on trucks, or passengers cars, or walking through the streets of that district, you have a diagrammatic picture of the American city street traffic problem.

The streets are the most valuable public utility a city possesses. If we did not have streets, we could not have any cities. Some years ago a sociologist defined a city as an area with a comparatively dense population, arranged in such a way that inter-communication through the territory is possible. If you will eliminate from your conception of a city the possibility of inter-communication over the streets, you cannot possibly visualize a city.

But there is another side of the picture as illustrated in Chicago. It is a pressing side; one which comes nearest to our hearts ordinarly. Last year traffic accidents killed in Chicago 645 people! Last year in the United States over 23,000 people lost their lives in motor car accidents, and hundreds of thousands were seriously injured. Last year we destroyed in property damages and accidents, traffic accidents, somewhere around $7,000,000.

Provide Facilities for Traffic Flow.—There are two important means of solving the traffic problem, neither one of which needs or demands the slightest amount of guess-work. The first is, of course, by the provision of adequate and well designed facilities for traffic flow. My business takes me over the country, from city to city, and I think unless you have had some definite experience of that kind you may be amazed to know that the majority of the street facilities that are being laid down at the present time are being laid down in a strictly traditional manner, entirely as though we still had a few horse and buggy units operating over our streets. In a city of 150,000, which I visited the other day, I found that the latest streets which were being laid down have a curb radius of 2 ft. Now a 2-ft. curb return might have been entirely suitable for horse and buggy operation. It is not suitable by any means for automotive operation. Again we find cities laying down streets entirely too narrow for the needs which can easily be seen arising tomorrow. On the other hand, we find cities which get so enthusiastic that they lay down roadways with a pavement of over one hundred feet in width, a capacity which will never be filled.

Logical city planning has become sufficiently definite from an engineering standpoint, so it is possible for a city planner to predicate needs of the future and lay down facilities which are going to meet those needs adequately. So I might go on through the field of city planning, pointing out how many cities are still guessing at their physical necessities, while some others, happily, have developed a technique which is not only sound and which saves their cities a great deal of money, but at the same time results in the introduction and construction of physical facilities of traffic regulation which are adequate and adjusted to the needs of traffic safety and traffic movement.

Study Methods of Traffic Control.—But that is not the aspect of the problem in which I am particalarly interested. The other is a solution for the problem of traffic congestion and accidents, which is practicable because of its immediate availability and because of the fact that it costs the city practically nothing. I mean by that methods of traffic control, which have proved their ability to reduce accidents and to reduce congestion.

The Erskine Bureau, of which I have the distinction of being Director, is endowed by the Studebaker Corporation for the particular purpose of carrying on, in connection with Harvard University, the development of the technique of highway traffic and street traffic control. When I say "development," I wish you to understand that while many useful methods have been developed, we have, as yet, only scratched the surface. The problem is developing even more rapidly than the best technique which we can possibly bring to bear upon the problem.

One of the most mooted of our traffic problems, a problem primarily has

bearing upon congestion, but a problem which secondarily has a very definite relation to the problem of public safety, is parking. I suppose that there is no use of the public streets which is more generally misunderstood than parking. I hold no brief for unlimited parking, but I do know there are available in every American city, facts which will tell accurately where the best interests of the community lie in any particular section with the parking problem.

The Parking Problem.—To just show you how far people can be wrong in guessing about traffic, so far as parking is concerned, I can cite Chicago. Fourteen months ago, when the metropolitan survey began in Chicago, a great many merchants were very much agitated as to what the survey would say in connection with restricted parking. They were very fearful that radical proposals would be made. They were assured that no proposals of any kind would be made until complete facts had been collected on that particular problem, cutting out guesswork and cutting out traditional ideas as to what ought to be done or what ought not to be done. Several merchants told me—they were owners of large stores in the Loop district—that from 33 to 50 per cent of their patronage came by means of patrons who parked their automobiles at the curb. Of course I knew they were making a wrong guess. I knew that that would have been quite impossible, as we subsequently discovered.

We went after facts. In the first place we made a careful study of the relation between parking upon various width streets and streets with various traffic characteristics, to see the degree of obstruction which existed. Now, of course, if parking causes no obstruction whatsoever, there is no reason whatsoever for its elimination. On the other hand, a considerable amount of obstruction could be tolerated if parking did not result in accidents, and if parking were important in the bringing of business. So to see the relation between parking in that particular district and the business activities that were carried on there, we conducted what was known as a Modes of Transportation Study, to discover the ways in which the great purchasing public of the Loop district came down to transact its business.

We studied during this one day in the Modes of Transportation Survey the habits of the 96,000 patrons of a varied assortment of retail establishments, principally in the department stores on State Street. We discovered that in no case did more than 2 per cent of the patrons come from curb parked machines, and that the average was 1.5 per cent of 96,000 people.

"Stop and Go" Signals.—But to draw my analogies from the Loop in Chicago to your own cities would be improper. Chicago has its own peculiar problem—and I might say, right here, parenthetically, one of the chief faults in traffic regulations in American cities today is not so much, perhaps, the attempt to solve those problems by guess-work, or the attempt to solve them by prejudice, but the attempt to solve them by analogy. I mean that Mr. Jones from a city of five thousand people goes to New York City and he finds in New York City a large number of one-way streets. He also sees a signal system on Fifth Avenue. He goes back to his own town and he says to the Council: "Men, you are behind the times here. Every other street crossing on Main Street ought to be a one-way street." So they put in one-way regulations. Or he says, "We ought to have a signal system on Main Street." And he fails to take into consideration that his Main Street may be very different from Fifth Avenue, farther fails to take into consideration that the Fifth Avenue signal system was antiquated some five years ago, although New York still continues to use it.

I point out that parking survey in Chicago particularly, to show you not that you could draw any conclusions for your own communities, but to point out the fact that even the most acute business men, who, presumably, keep accurate records of business operations, from day to day, are frequently entirely mistaken as to where their real interests lie in the regulation of traffic.

Another matter upon which there is a great deal of guessing is to be found in the methods installation of mechanical control apparatus, which communities use at the present time in the "Stop and Go" signals. I have a great many friends among the manufacturers of traffic signals, but I think it perfectly proper to say that at least 50 per cent of the stop and go signals that have been put in American cities ought never to have been installed. Guessing that, because the starting and stopping of traffic at certain places may have had desirable results, that it is, therefore, a kind of a panacea for all problems of congestion, or all problems of accidents, has led to a very great deal of interference with traffic flow.

We could obtain complete safety in traffic if we should stop all traffic. That of course, is impossible. So in every regulation that is considered, there must be, as accurately as possible, a balance between the requirements for safe movement and the requirements for expeditions movement.

Traffic signals, as I say, are again illustrative of a great deal of guesswork. Just to show you how far guesswork can go, I was in a city in the West some few months ago, and an appropriation was provided for twenty-five new signal installations. There happened to be thirteen members in the Council Board, elected from wards. The signa's were located in this way. One councilman was very generous and said he would be willing to take only one signal, so the other signals were divided up evenly among the other councilmen. That, unfortunately, is the way such matters are sometimes handled.

Boulevard "Stop" Regulations.—Another type of regulation in which guess-work has done harm is in the installation of boulevard stop regulations. A better, more simple and effective method of permitting reasonably high speeds with safety I do not know. It is perfectly simple, and is easily installed, yet it is one that has come greatly into disfavor in certain sections of the country because it has been installed ordinarily entirely by guess-work. I will show you just how far guess-work goes.

In Venice, California, which is now a part of the city of Los Angeles, there is a boulevard stop at successive intersections along one of the major highways running through that city for twenty-six blocks. Twenty-six stops in a distanae of about a mile and a half, on one of the most important thoroughfares. The guess has been this: a boulevard stop promotes safety; we want safety—therefore, let us put in many boulevard stops. I say twenty-six stops are required in about a mile and a half. I think you may imagine whether the motoring public complies with that requirement or not. Moreover I have seen boulevard stops or thorough stop-streets carried right down into a heavily congested business district, where anyone who had ever considered the operation of streets of that kind, and their characteristics, would know that the rule would not work. It results only in confusion and in unnecessary delay.

I have already mentioned one-way streets and the way they have been slapped down in places throughout America, in cities where there was never the slightest shadow of use for them. A one-way street has a very limited application. It causes diversion of traffic, and there is always a presumption against its use. It becomes useful and valuable only upon extremely narrow streets where there is heavy traffic movement.

Street Car Problem. — One of the most distressing instances of guesswork and prejudice in an attempt to solve the traffic problem—I might say is almost typical of American cities—is to be found in the relations between street car operation and automobiles. I find many of my strongest supporters among traction officials, though the Bureau I direct is endowed by the automobile industry, so you see I am in a position to talk on both sides rather freely. Unfortunately many street car companies are very prejudiced against the automobile. The typical attitude of these companies is: Drive the automobiles off the street in

order we may get our mass carriers through. Prejudice and guess-work! But this is only one side, for automobile trade associations, and automobile clubs are often just as vigorous and just as prejudiced in a desire to handicap and limit the operation of mass carriers.

Organize for Safety.—I have always found if you get the street car operators and the automobile club people to sit down around a table sufficiently wide so they won't hit each other, and sit still for just a few minutes, until we have begun to talk this over, they are usually amazed at the end of a very short consideration of some facts about their operation to find that instead of having problems that are diametrically opposed, that their problems are entirely mutual. If each of them will merely give up a little bit of what they had been claiming, drop their prejudices and be willing to look at facts instead of guesses, both of them come out in much better position than they were.

We find cities all over the country aroused about safety. We find every civic organization, and every club organization, and every other kind of group of citizens that have the slightest excuse, interesting themselves in the problem of public safety. This is indicative of the great interest and great pressure which that problem has within it. And yet, so rarely do we see any agency attempting to do anything but the most vague guess-work about the problem of public accidents.

There is no sound way of approaching the safety problem, any more than there is a sound way of approaching the problem of traffic congestion without knowing the facts. Guesses may be good. All of us must occasionally guess, where there is no experience to guide, no fixed rule. The least we can do is to be reasonably honest with ourselves and take our guess for mere opinions. When we are given the responsibility of dealing with a situation which involves millions of dollars of property, and hundreds of lives, the least we can do is to be certain of our ground.

In its last analysis traffic is a problem of engineering. Traffic problems must be administered as other physical and engineering problems, and not as though they were similar to matters of political policy. The Erskine Bureau has attempted to develop traffic engineering technique. We have done this largely by means of carrying on investigations in the larger American cities. We have just completed the Chicago survey, and have published a report of approximately 300 pages, setting forth there a kind of inventory, as it were, of facts regarding accidents and congestion. We have attempted to set up a method of approach in that city which will make possible a continuing application, not of guess-work or prejudice, but of engineering principles. I am happy to say that Chicago has at the present time a Division of Street Traffic Engineering. They are giving it just a little fraction of the attention now which they have been giving to sewers and water supply before. And it is, I think, not by guess-work, and not by prejudice, but by knowing the characteristics of our problem and by adjusting rational methods of regulation to those facts, that we are going to even begin a relief of the problem, to say nothing of its solution.—ALABAMA HIGHWAYS.

Jay Walking Retards Traffic

Jay walking as a pedestrian pastime is a losing game, according to scientific traffic studies made by the Albert Russel Erskine Bureau of Street Traffic Research, which has found that the pedestrian who ignores traffic signals and rushes across street intersections without their protection has less than one chance in three of reaching the other curb without wasting more time than he saves.

A study of the walking habits of more than a million and a half people, which forms part of the report of the Chicago Street Traffic Survey made by Miller McClintock, director of the Erskine Bureau, confirms the warnings of safety experts that the jay walker seldom saves time by his infraction of traffic rules. Results of various checks made at typical street intersections showed that more than half of the pedestrians held up by movement of cross traffic attempt to break through the traffic stream against the signal lights, but that only approximately one-third of those who make the attempt are successful in reaching the opposite curb. The rest are caught between moving lines of traffic in the center of the roadway, endangering themselves and materially reducing the speed and volume of traffic flowing through the intersection.

Other studies made in Chicago's "loop" business district developed that the pedestrian tendency to jay walk results in a serious retardation of the speed and volume of traffic movement. Intersections capable of carrying two lines of traffic safely at a speed of fifteen miles per hour are often reduced to one lane moving at a speed of ten miles an hour.

The importance of the street intersection is obvious when it is realized that the intersection is the key to the problem of traffic congestion on any busy street. "The streets can carry no more traffic than can be passed by the intersections," says the survey's report. "Thus if the capacity of the intersections is reduced fifty per cent by pedestrian interference, the streets can carry no more than half their full capacity."

"Reduction of traffic capacity is not to be found only at the intersections, where conflicts exist between pedestrians, but in mid-block as well," the report continues. "Motor vehicles cannot move safely when at any moment pedestrians are likely to appear in their path.

"The amount of this type of mid-block interference is not generally realized. Counts at a number of locations in the central "loop" district showed that during the noon hour, 12 to 1 P. M., the number of pedestrians crossing at places other than at the intersections numbered more than 1,000 per block." Near State and Madison Sts., whose intersection makes the world's busiest corner, nearly double this number left the sidewalks to mix with and delay motor traffic in the middle of the block.

To reduce the congestion and waste of time occasioned by this one phase of the traffic problem the report of the survey recommended that jay walking be prohibited, with suitable penalties for violation—jay walking being defined as the practice of pedestrians crossing other than at street intersections.

In order to reduce the inconvenience of pedestrians to a minimum and to introduce a degree of flexibility into the rule, the report also proposed that crossings be placed near the middle of blocks in districts where the distance between intersections exceeds 400 ft., and that in such cross walks pedestrians be permitted to cross with a right of way over vehicular traffic.

Water Softening Plant for Marion, O.

Plans have been approved by the State Department of Health of Ohio for a water softening plant to be constructed at Marion, O., by the Marion Water Co. Marion has always had a water supply of satisfactory sanitary quality but the water is hard and contains iron which renders it undesirable for domestic uses. Hardness of the water is about 700 parts per million, or 41 grains, which is probably the hardest water of any city supply in this state. Normal capacity of the plant is 5,000,000 gal. daily. The unusual features of the plant are the devices for handling and storage of chemicals, the large Dorr clarifier and the long detention therein, the large sedimentation tank following the clarifier, and the omission of filters. It is anticipated that with the long detention periods in the clarifier and sedimentation tank that a clear water will be produced. In the omission of filters the Marion plant is similar to the plant at Oberlin, which was the first municipal water softening plant in the United States. Charles P. Hoover of Columbus, O., is the designing engineer.

Water Softening at Springfield

10 Months' Experiences Described in Paper Presented Before Iowa Section American Water Works Association

By CHARLES H. SPAULDING
Superintendent of Filtration, Springfield, Ill.

The water-softening plant at Springfield, Ill., has been in operation about ten months. In this short period it has met a variety of loads and conditions.

Water-Softening Plant.—The raw water is collected in a well 60 feet in diameter by 53 feet deep, to which it flows by gravity from galleries or the river or is pumped from the tubular wells. Low-lift pumps deliver the raw water from this reservoir to the dosing well at the end of the head-house adjoining the chemical preparation room, where lime and coagulant are added. Thence it passes to two parallel reaction chambers, where it is stirred by mechanical agitators revolving at 0.6 r.p.m. The chambers are 42 ft. 8 in. in diameter, and the speed of the paddles at the two-thirds point is therefore 0.8 ft. per second. The mixing period is 40 minutes at the nominal plant capacity of 12 m.g.d.

From the mixing chambers the water passes through two Dorr clarifiers in parallel, thence through settling-basins having carbonating chambers at the outlet ends, and finally passes to the eight filter units of the rapid sand type. The detention period in the Dorr clarifiers is 1 hour and 30 minutes, and in the settling-basins four hours. The carbonating chambers provide 30 minutes further detention.

Features of the Plant.—A feature of the plant which proved valuable during high water is the continuous removal of sludge from the clarifiers. For a period of six weeks it would have been impossible to drain the basins for cleaning, and if sludge storage had been provided for such a period the basins would have been necessarily larger.

Another satisfactory feature of the Springfield plant is the lime-unloading equipment. Quicklime is used because of its lower first cost and higher softening value as compared to hydrated lime.

Table I—Chemical and Bacterial Results of Water Purification

	July	Aug.	Sept.	Oct.
Turbidity:				
Raw	38.0	64.0	24.0	9.0
Applied	2.0	3.5	3.5	3.0
Filtered	0.3	0.3	0.3	0.2
Hardness:				
Raw	274	232	267	260
Filtered	145	92	125	102
Total Count Bacteria per cc. 37½° C 24 Hr.:				
Raw	420	3,988	395	321
Clarified	106	141	73	13
Applied	64	58	44	11
Filtered	36	22	10	5
Final effluent	13	5	4	2
B. Coli per 100 cc.:				
Raw	64.0	7,000.0	1,558.0	242.0
Clarified	5.0	139.0	49.0	37.0
Applied	11.0	44.0	6.0	8.0
Filtered	0.0	3.2	1.0	0.7
Final effluent	0.2	0.2	0.0	0.2

Table II—Operation Statistics

	July	Aug.	Sept.	Oct.
Mil. gals. delivered	183	252	221	214
Rate of filtration	1.63	1.53	1.44	1.31
Length of runs	21.2	24.0	42.4	57.9
Per cent wash water	3.0	3.1	2.8	1.5
Chemicals per Mil. Gals.:				
Lime	1,500	1,530	1,493	1,330
Aluminum sulphate	131	132	56	27
Chlorine	3.4	2.9	2.8	1.9

The material is received in bulk and unloaded by means of a vacuum conveyor which lifts it to the third floor of the head-house, where a screw conveyor distributes it to the three lime bunkers. One man unloads 30 tons of lime in from four to six hours without discomfort or undue exertion.

Lime-weighing hoppers are conveniently located beneath the lime bins. After being weighed, the lime is dropped into slackers and thence into the batch tanks located in the basement below. From these tanks the lime suspension is pumped to the wet feed machines over the dosing well.

Steam jets were originally provided for this lift, but the discharge line just beyond the jet would scale up with a flinty lime deposit in about one week, so that the 2-in. pipe was reduced to about ½-in. opening. It was decided to substitute a small centrifugal pump, and but little trouble has been experienced since this change was made. For the benefit of others who may have trouble with lime stoppage on solution lines I will say that one of our men found if he threw one of the plugged nipples into a fire it would explode and blow itself clean. It is a rapid method and should be used with caution.

Chemical and Bacterial Data.—A glance at a brief summary of some of the chemical and bacterial data (Table I) on plant operation shows the sort of work the plant is doing. No very high turbidities have been encountered, but the reduction through the basins and filters has been satisfactory. The filtered water always appears bright and sparkling in the gate chamber of the clear well even though the turbidimeter shows measurable values.

Hardness removal was begun gradually in July. September floods cut off the lime supply temporarily and made economy necessary, resulting in somewhat harder effluent. October showed about what could be expected from the well water without over-treatment or the use of considerable coagulant. Results in August indicated that if satisfactory river water were available, a softer effluent might result. Coagulant cost, however, would be higher in this case.

The sanitary quality of the raw water has fluctuated widely. The load depends primarily on the proportion of river water used; thus, August, the month of greatest daily pumpage, showed the highest counts, especially in the B. Coli index. The B. Coli index of the Sangamon River at Springfield is in the neighborhood of 50,000 per 100 c.c. during normal stage. If we were compelled to depend on the river for as much as half our supply, we should have a real problem.

During the first few weeks of operation in July the supply was drawn almost entirely from the wells and gallery. Small quantities of river water were used during September and October, but sufficient to bring the averages up. It is interesting to note that at this plant the most important removal occurs in the first two hours of sedimentation, as shown by the clarifier effluent. The additional six hours which the water had in the settling-basins had relatively less effect. The filters show fairly high efficiencies.

Operation Statistics.—Turning next to operation statistics, (Table II) we may note first that the length of filter runs has increased during September and October and wash water has decreased to 1.5 per cent. Wash water is not a major item of cost at present, as it is discharged to a sump and returned to the dosing well, so that the only loss is the pumping cost.

Lime now averages 1,330 pounds per million gallons. During the last two weeks of October no alum was used, and chlorine was also discontinued, since B. Coli was rare even in the clarifier effluent.

Cost.—A study of costs (Table III) during these first months is interesting, for it appears that if sufficient ground water were available it might be cheaper and certainly would be more sanitary. A number of economies, such as coagulant, chlorine, return of wash water, and less supervision, may well balance the cost of pumping and maintenance of wells. The total purification cost during October, 1926, was $16.22 per million gallons (exclusive of fixed charges). This may be compared with $19.41 per million gallons when 10 to 20 per cent of river water was used. It will doubtless be necessary to use some river water as in the past. On the other hand, it is plain that the wells will be the preferred source until the river shows marked improvement.

Table III—Operating Costs

	Cost per Month				Cost per Mil. Gals.			
	July	Aug.	Sept.	Oct.	July	Aug.	Sept.	Oct.
Lime	1,467.50	1,990.35	1,643.20	1,435.55	8.00	7.87	7.44	6.70
Coagulant	335.36	481.60	173.43	81.78	1.83	1.91	.78	.38
Chlorine	63.05	73.30	62.00	42.10	.34	.28	.28	.20
Misc. sup. and expense	157.85	216.04	180.77	22.11	.86	.86	.82	.10
Maintenance	17.00	26.13	16.00	0	.09	.10	.07	.00
Labor and superintendence	1,111.40	1,191.99	1,178.80	1,141.00	6.06	4.72	5.23	5.34
Low-lift pumping	546.73	766.90	570.30	588.00	2.98	3.04	2.58	2.75
Misc. elec. current	172.00	158.20	171.30	160.50	.94	.63	.78	.75
Totals	3,870.89	4,721.01	4,139.30	3,582.54	21.10	19.41	17.98	16.22
Mil. gals. delivered	183.37	252.57	221.21	213.98				
Cost per mil. gal. per p.p.m. hardness removed	.164	.139	.127	.103				

New Sewage Disposal Works of Fostoria, Ohio

Separate Digestion of Sludge, Artificial Heating of Tanks and Other Features Described in Proceedings Engineers' Society of Western Pennsylvania

By J. F. LABOON

Member, J. N. Chester, Engineers, Pittsburgh, Pa.

Much has been written of the trend of present-day practice in the art of sewage disposal, the most important developments of which are so-called detritus tanks where the ever present and increasing quantities of grease from garages and industries are intercepted in conjunction with grit in the combined type of sewerage system; the separate digestion of sludge in disposal plants as contrasted to the Imhoff or two-story tank type; and the application of means for the digestion of the sludge developed in enormous quantities in the activated-sludge type of disposal plant.

The second of the important developments listed in the previous paragraph has been adopted in the design of the proposed improvements to the sewage disposal plant of the city of Fostoria, O.

Design Considerations. — The engineers designed a separate sluge-digestion system of sewage disposal after having given consideration to the several practical types applicable to the conditions at Fostoria. Two types of sewage disposal plant offered the best solution, economically and from the standpoint of practical and successful operation. These were (1) Imhoff tanks with trickling filters; and (2) separate sludge digestion with trickling filters. Either would serve well. Cost studies showed that an Imhoff-tank plant with trickling filters incorporating the existing Imhok tank as part of the new plant would cost $240,000, whereas a separate sludge-digestion system of disposal, using the existing Imhoff tank as a sludge-digestion tank, upon remodeling, would cost $210,000. The substitution of trickling filters for sand filters became necessary from the stand-point of economics, as the sand beds would have had to be completely reconstructed to conform to modern practice, and a 3-ft. depth of sand, instead of 11 in. as now constructed, would be required. This would have involved a cost far greater than will be the case with trickling filters. The existing sand beds, therefore, are to be abandoned. The elevation of the existing Imhoff tank would not permit the installation of a trickling filter of an optimum depth, followed by humus tanks without additional pumping; furthermore, any increased depth of structures underground would increase the cost materially by virtue of the underlying stratum of rock located a few feet below the ground surface. It would have been necessary in the use of an Imhoff tank design to raise the existing Imhoff tank at least 4 feet, which would require a general strengthening of the tank to withstand the additional head of water placed upon it, as the tank was already in a weakened condition. With separate sludge digestion the existing Imhoff tank can be utilized in its present condition without increasing the height of its walls, and to complete the system it is necessary only to construct the clarifier tanks at an elevation sufficient to give proper fall to the trickling filter and humus tanks, and to permit the discharge of sludge from the clarifier tanks into the separate sludge-digestion tank by gravity. The simplicity of adaptation of the existing plant and the lesser cost involved pointed to the adoption of the separate sludge-digestion scheme of disposal.

It has been said that the separate sludge-digestion system of disposal presents problems requiring more technical supervision and operation than is the case with the Imhoff-tank type of disposal, but after practical experience with the operation of Imhoff tanks and observation and personal study of separate sludge-digestion plants this statement may be made in its reversed form —that the separate sludge-digestion system of disposal makes it possible to give more technical supervision and operation and is, therefore, amenable to more intelligent operation; bearing in mind that digestion of sludge and a satisfactory effluent are the prime functions of a sewage disposal plant, but that these operations shall be performed with a minimum of odors.

Outline of Improvements.—The new improvements consist of:

1. The installation of grit-handling apparatus.
2. A high-water alarm.
3. New vertical pumps and motors to replace the horizontal units.
4. The construction of an addition to the existing pumping station to house a chemical and bacteriological laboratory, toilet and locker room, and lime-feed devices.
5. The transformation of the existing water-pump house into a tool house.
6. The transformation of the existing Imhoff tank into a separate sludge-digestion tank.
7. The construction of sewage thickeners or clarifiers.
8. Dosing tanks.
9. Trickling filter.
10. Humus tanks.
11. New outfall sewer.
12. Resurfacing and reconstruction of existing sludge beds or the construction of a glass-covered sludge bed as an alternate.
13. Roads and walks.
14. Water line and gas line connecting to existing utilities in the city.
15. The provision of a complete outfit of tools and operating equipment.

Population.—According to the city director of 1925, the best source of information available, Fostoria has a population slightly under 12,000, with every indication of a healthy growth by virtue of the industrial character of the city and particularly because of the extensive industrial developments now in progress. The area of the city within the corporate limits is 4.2 square miles. Five main-line railroads enter the city.

Quantity of Sewage.—To develop the present quantity of sewage flow, an accurate record was kept of the time and number of pumpages, and the time cycle of each pumpage for a 24-hour period beginning at 9 a. m., Aug. 18, ending at 9:13 a. m., Aug. 19, 1926. From these data, having observed the output of the pump in gallons per minute, it was possible to determine the total sewage flow and its variation over the 24-hour period. The developed curve indicates a minimum flow of 1,000,000 gal. a day, a maximum of 2,650,000 gal. a day, and an average of 1,600,000 gal., or approximately 133 gal. per capita as a dry-weather measure. The hourly pumpage at the waterworks for Oct. 20-21, 1926, is shown in the same diagram for the purpose of comparison of the two curves. The period immediately preceding the 24-hour sewage measurement was fairly dry and the statement that these results were found under dry-weather conditions is supported by a comparison of these data with the weir measurements made April 17, 1923, during a wet period in the spring. The weir measurements of 1923 gave an average per capita flow of 169 gal.

Character of Sewage.—A composite sample of sewage was collected over a 24-hour period at each fifth pumping-cycle period, representing approximately 15-minute intervals. These samples were taken simultaneously with the observations for quantity of sewage on Aug. 18-19. The results of the chemical analysis of the composite sample follows. Due to the failure to add chloroform to the sample when col-

lecting, nitrogen and ammonias could not be determined.

	Parts per million
Total solids	1650
Suspended solids	350
Chlorids	80
Oxygen consumed	47
Dissolved oxygen	0
Alkalinity to methyl orange	130
Total iron (mostly ferrous)	70

The acid nature of the sewage experienced at times has already been discussed. It is evident from the above analysis that the neutralizing plant at the wire mills was in effective operation, although a large amount of iron found its way into the city sewers.

Capacity of Plant.—The new improvements have been designed with a view to treating sewage from a population of 15,000, which will permit of more than 25 per cent growth in the present population. The sewage flow has been taken as 133 gal. per capita as revealed by the measurements of Aug. 18-19, 1926; and the minimum and maximum flows of the new design are based on the results of these measurements. The design flows are:

Minimum,	1,250,000 gal. a day
Maximum,	3,310,000 gal. a day
Average,	2,000,000 gal. a day

Grit-Handling Apparatus.—Over the grit chamber is to be erected a monorail system for carrying an electric hoist operating a ⅜ cu. yd. grab bucket by means of which the intercepted grit will be removed from either channel and loaded into carts or trucks at the end of the grit chamber. Lighting fixtures are being installed over the grit chamber for the convenience of the operator at night.

High-Water Alarm. — A high-water alarm of the float type is to be installed in the screen compartment of the grit chamber to warn the operators of an abnormal sewage flow such as would be experienced in case of rain and to warn of a rise in the sewage ahead of the screens due to the failure to remove screenings, in either of which cases the operator's attention would be called to the necessity of investigation. Should the rise be due to rainfall and the pumps be unable to handle the sewage flow, the station would then be shut down until the flow to the sewage plant became sufficiently reduced to permit of resumption of operations.

Pumps.—The dry pump pit has been flooded on a number of occasions with consequent damage to the motors. It is proposed to install two pumps—one of 2,500,000 and one of 3,500,000 gal. per day capacity. These are to be vertical motor-driven centrifugal pumps with motors located above the level of the operating floor. These pumps are to be of the Wood-Trash, Yeoman, Hayton, Buffalo or similar type, with impellers designed so that balls of diameter practically equivalent to that of the discharge pipe may pass through unobstructed. The pumps will be operated automatically by means of float switches. These switches will be arranged to control the speed of the motors, depending upon the height of sewage in the wet well. There will be four float switches serving either pump, regulating the speed at four points, namely, 80, 87, 93 and 100 per cent. The purpose is to obtain as nearly constant flow of sewage through the plant as is practical, as this will be conducive to the best results.

Laboratories, Etc. — A laboratory equipped with apparatus for making ordinary sewage analyses is incorporated as a part of the addition to the existing sewage pumping station building. This addition will also include a locker room, toilet room, and a room where a machine for dry feeding of lime will be installed, with space for the storage of lime. A basement is being constructed under the lime-feed room for the accommodation of the heating plant and sewage-gas apparatus.

Tool House. — The existing water-pump house will be transformed into a tool house where shovels and such tools will be kept.

Separate Sludge-Digestion Tank. — The existing Imhoff tank will be remodeled in such a way as to serve as a separate sludge-digestion tank. Part of the existing concrete baffles will be removed, thus eliminating the sedimentation compartment of the old Imhoff tank. A valved sludge pipe is being installed for each of the three hopper bottoms, whereby sludge may be distributed as desired. At the bottom of the tanks is being installed a new water-agitating system consisting of perforated, 2-in., wrought-iron pipe to replace the lead pipes which were removed without warrant when the improvements were made in 1923. A system of heating coils of 1¼-in., wrought-iron pipe is being installed in the tank for the application of heat to the digesting sludge, thus shortening the period of digestion in case it becomes desirable to do so during the winter months when sludge may be allowed to accumulate due to undesirable drying conditions. The heater, which will serve both the sludge-digestion compartment and the heating of the buildings, will be arranged to use gas to be collected from the separate sludge-digestion tank. A partially submerged concrete roof is to be installed over the entire surface of the tank for several purposes, among which are the prevention of odors, the submersion of scum, the collection of gases and the insulation of the sewage against cold. Three gas-collecting tanks of galvanized iron are to be installed in the concrete cover for the purpose of collecting sewage gases. These tanks are connected to the piping leading to the gas scrubber located in the lime-feed room, and are further connected to the gas-storage tank supplying the heater. The sludge will be fed from the thickeners into the separate sludge-digestion tank by gravity, and the displaced liquid will flow out through a swinging outlet pipe which discharges into the sewage well. A dry lime-feed machine has been added to the equipment in the extension of the pump-station building. The purpose of this machine will be to feed lime into the sludge line leading from the thickener to the separate sludge-digestion tank, in order that the optimum hydrogen-ion concentration of the sludge may be maintained with the resulting elimination of acid digestion. A water ejector will be used for feeding the lime into the sludge line under pressure. Mixing between the lime and sludge will be accomplished in the remaining travel through the sludge pipe. The capacity of the remodeled tank is 60,000 cu. ft., or 4 cu. ft. per capita, but all of this will hardly be available as actual sludge capacity.

The design of the several features of the separate digestion of sludge has been based on experiments conducted by Dr. Rudolfs at the New Jersey Sewage Experiment Station as substantially confirmed by Mr. Baity in his research work at Harvard Engineering School and as applied in a practical way by John R. Downes, superintendent of the sewage disposal plant at Plainfield, N. J. The substantial developments are with respect to the control of the character of sludge digestion by means of the hydrogen-ion concentration; the acceleration of digestion by the application of the heat; and the maintenance of anaërobic digestion of sludge. Generally speaking, it may be said that research work has developed optimum pH valves of 7.3 to 7.6 and temperatures of 78 to 80 degrees F. The character and quantity of production of gas may be governed by the control of pH and temperature. The gas must be washed of its CO_2 to develop its best combustible qualities, and a scrubber for washing out the CO_2 is therefore provided for this purpose. It is hoped that sufficient gas will be produced to furnish the heat necessary to maintain optimum temperatures throughout the year and leave a surplus for other purposes.

Settling Tanks and Sewage Thickeners.—Two sewage thickeners of the Dorr and Link-Belt type have been designed for use in the settling tanks with a view to obtaining bids on both types. Both lay-outs have a detention capacity of two hours at average design flow. These tanks are to be fully equipped with an economical type of sewage thickener. The difference in head between the thickeners and the separate sludge-digestion tank is 4.33 ft. The flow of the thickened sewage will be controlled by means of hand-operated gate-valves. Sampling pipes discharging into open sewers leading to the wet well are provided for each sludge pipe, so that the character of the thickened sludge may be inspected during the discharge of the sludge to the sludge-digestion tank. The tanks of the Dorr

type are each 30 ft. square and 12 ft., 6 in. deep; while those of the Link-Belt type are each 18 ft. wide, 50 ft. long, and 13 ft. deep. It is proposed to remove sludge twice daily. The Link-Belt scraper type would operate about 30 minutes daily, while the Dorr thickeners, if installed, would operate as required. The Link-Belt type will present the added feature of having the return flight of the scraper operate at the surface of the sewage tank so as to skim off the floating matter, particularly grease.

Dosing Tanks.—Two dosing tanks are to be built, equipped with 20-in. siphons of the type known as No. 2, manufactured by the Pacific Flush Tank Company. Each tank has a capacity of 8,300 gal. A 6-ft. automatic air-lock feed is provided with each tank. The computed losses are as follows:

Feed	8 in.
Weir	8 in.
Distribution	8 in.

The operating cycles are computed to be as follows:

	Millions of gallons a day	Discharge minutes	Resting minutes
At capacity of larger pump	3.5	2½	0.9
At design average flow	2	2½	3.5
At design minimum flow	1.25	2½	7
At design maximum flow	3.3	2½	1
At present average flow	1.6	2½	5
At present minimum flow	1	2½	9.5

An overflow weir and by-pass sluice gate have been provided integral with the sewage-inlet channel, primarily so that sewage may be by-passed around the dosing tanks and the trickling filter in the winter, if found advisable. The dosing tanks are to be located in the existing sand filters just above the proposed trickling filter.

Trickling Filter.—The trickling filter is rated at 2,500 people per acre per foot depth, and on the basis of an average depth of 7 ft. and a population of 15,000 people the area becomes six-sevenths of an acre. The trickling filter as designed has surface dimensions of 188 ft., 3 in., by 190 ft.; while the dimensions at the bottom are 183 ft., 9 in., and 185 ft., 6 in. The sewage will be distributed through a single cast-iron distributing main laid at the surface of the bed, from which 6-in. cast-iron laterals will branch off on both sides. The filter stone, as specified, is to consist of suitable limestone ranging in size from 1½ to 2½ in. It is proposed to use 246 full nozzles and 18 half nozzles of either the latest improved ⅞-in. Taylor type, or the $\frac{13}{16}$-in. Worcester type. The maximum net head is 6 ft. These nozzles are spaced 12.25 ft. from center to center, measured along the sides of an isosceles triangle. The underdrainage system is patterened somewhat after the Fitchburg type, and bids will be requested on four alternates of substantially the same design, differing only in the method of installation. Two main drainage gutters terminate in 18-in. terra-cotta mains leading to the humus tanks. Bids will be requested on waterproofing the tops of the walls and the sides 1 ft. down from the top around the four sides of the trickling filter.

Humus Tanks.—Two humus tanks are being provided, with a combined capacity of 1½ hours at normal flow. Hydraulic plug valves are being provided at each of the drain outlets. A control manhole is located at the end of the tanks. A 10-in. terra-cotta drain leads from the humus tank to the raw sewage pump well. This becomes necessary to save pumping, as the bottom is too low to drain into the river. The tops of the walls are designed at elevation 854.25, which is approximately 2 ft. lower than the local high-water record. These tanks will be flooded at high water, but no harm can be done except the settling out in the tanks of some mud from the flood waters, and no backing up into the trickling filter will be possible if the operators take the precaution to close the gates on the inflow lines entering the humus tanks. Designs have been made for tanks accommodating Dorr and Link-Belt thickening equipment, so that daily removal of the accumulated sludge may be accomplished. It is well known that the accumulation of sludge in humus tanks is a common source of vile odors to be found at sewage disposal plants, and it is with the purpose in mind to avoid such a condition that daily removal of this sludge is desired. It is agreed that the detention period of the humus tanks may be reduced to one hour with the installation of thickening equipment, in contrast to the period of 1½ hours required with plain settling tanks. Bids will be received on the plain tanks, on the Dorr thickeners, and on the Link-Belt thickeners, and contracts will be let on the basis of the funds available for the purpose.

New Outfall Sewer.—A new outfall sewer has been designed to discharge from the humus tanks into the Portage River about 100 ft. distant. A concrete abutment is being installed at the river end. The old outfall sewer will be used during the winter at such periods as the trickling filter is being by-passed.

Reconstruction of Existing Sludge Beds.—All of the existing sludge beds will be resurfaced to the extent of replacing the 3-in. layer of sand with 5 in. of sand. Sludge carriers of the manure carrier type are to be installed in pairs over each sludge bed. These will be sufficiently high to permit dumping into a cart or truck at the end of the beds. The unloading end of the trolley will be lower to relieve the burden of pushing the loaded carrier. The drains in sludge beds 3 and 4 will be reconstructed to drain into the 10-in. terra-cotta drain leading to the raw sewage well, as these beds are now back flooded during high waters. This reconstruction will prevent such back flooding. The concrete trough leading from the existing Imhoff tank to old sludge beds 1 and 2 will be replaced by an underground sludge pipe leading to the existing distribution chamber. The existing concrete trough will be destroyed and removed.

An alternate to the above work consists in a design of a glass cover over sludge bed No. 4 involving an area of 5,600 sq. ft. Should the city funds and the nature of the competitive bids justify it, the cover over sludge bed No. 4 and the reconstruction of the bed will be undertaken in preference to the reconstruction of all of the open beds. The adjoining sludge bed, No. 3, will be left intact for future use and development as found necessary, while the old sludge beds 1 and 2 will be destroyed, as there will be no occasion for their use for a great many years to come, if ever.

The total area of the sludge beds now existent is 20,000 sq. ft., which is equivalent to 1.74 ft. per capita on the basis of the existing population of approximately 11,500, and 1.33 sq. ft. on the design basis of 15,000. For future extension, existing sludge bed No. 3 may be reconstructed and used as an open bed, or a cover may be erected over it, thus permitting of doubling the capacity.

Roads and Walks.—New roads and walks will be built throughout the plant and the entire grounds will be seeded and made presentable.

Water and Gas Lines.—A 4-in. water line and a 2-in. gas line are to be constructed from County Line Street at Union Court to the sewage disposal plant, to provide water for all general purposes and gas for use in the laboratories and for heating when necessary. The water-line improvement was contemplated in the original plans for the improvement of the sewage disposal plant designed by the writer's firm in 1923, but the bids on this item were rejected and the existing water pump was reinstalled to supply water from the outfall sewer.

Estimated Cost.—The cost of the improvements is estimated at $200,000. These funds are to be provided through special legislation of the emergency order, as provided for by statute. In the state of Ohio, it is possible to issue bonds in the sum of 3 per cent. of the assessed valuation for any sanitary improvements ordered by the State Department of Health, without the necessity of submitting the question to referendum. The enabling act has been of great value to the people in obtaining required improvements to the waterworks and sewage systems throughout the state. Another act of great value to municipalities in the state of Ohio is the one recently passed by the state legislature permitting the collection of sewer rentals in the same manner as revenues for the use of water supplied by the waterworks, thus making a direct assessment against

those benefited by the sewerage system. The revenues collected from such rentals may be used in defraying the expenses of operation of both the sewerage and sewage disposal systems of the municipality. The approval of the plans and specifications of the Fostoria improvements are predicted on the city's instituting the sewer-rental measure and the provision of technical operation of the sewage works.

[Since the above paper was presented bids have been taken and the contracts let on March 16, 1927. In his closure Mr. Laborn gives the following additional information.—Editor.]

Author's Closure.—In addition to the letting of contracts on the predetermined improvements, contracts have also been let for several of the alternate items, such as the covering of sludge bed No. 4, by glass; the installation of Dorr clarifiers in the preliminary settling tanks; the installation of a 50-ft. Dorr clarifier in the humus tank; the resurfacing and reconstruction of sludge bed No. 3; and the installation of two monorails for the removal of dried sludge, which improvements will double the area of the sludge beds and permit the use of sludge bed No. 3 or the open sludge bed during the summer months, if necessary; the installation of the Metropolitan system of trickling filtered bottom; and the adoption of universal pipe for the trickling filter distribution system.

The clarifiers adopted are of the revolving type as manufactured by the Dorr Company; but one humus tank is to be constructed and equipped with the revolving-type clarifiers in place of the two plain settling tanks originally designed and described in the paper. The detention period of the single tank has been reduced to one hour, based on the average flow, in contrast to the 1½-hr. detention period of the combined plain settling tanks. It is believed that one hour detention in a single tank equipped with a clarifier is more than equal to the results which can be produced with 1½ hours detention in plain settling tanks. The contract prices follow:

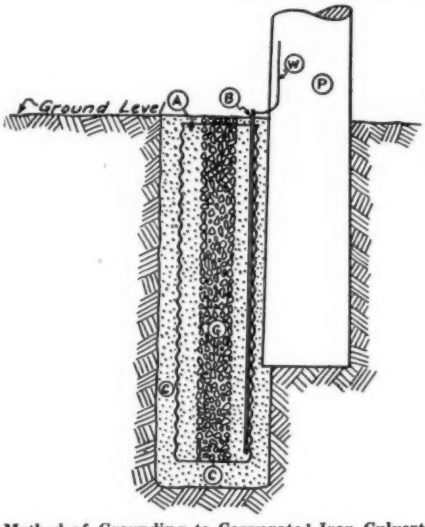
Contract 12.	Excavation and grading complete plant	$116,596
	Rebuilding and equipment sludge bed No. 3	2,400
	Asphaltic joints in trickling filter	100
Contract 13.	Cast-iron pipe and findings	5,938
Contract 14B.	Universal pipe	3,569
Contract 15.	Gate-valves	739
Contract 16.	Valve boxes	91
Contract 17.	Sluice-gates	1,325
Contract 18.	Tide gates	(Not required)
Contract 19.	Hydraulic plug valves	(Not required)
Contract 20.	Check-valves	151
Contract 21.	Stone for trickling filter	17,938
Contract 22.	Nozzles for trickling filter	559
Contract 23.	Clarifier apparatus	15,590
Contract 24.	Pumps	7,400
Contract 25.	Chemical feed machine	363
Contract 26.	Venturi meter	1,342
Contract 27.	High-water alarm	200
Total		$174,301
Estimated cost, less 10 per cent. for engineering and contingencies		$180,000

Grounding Electrical Equipment

How Corrugated Iron Culvert Pipe Are Used for This Purpose

By F. H. BUFFINGTON
Columbia Gas and Electric Corporation

Electric companies and other distributors of electricity are constantly confronted with the necessity for providing suitable grounds for lightning arresters, transformer-bank neutrals, and various types of electrical machinery. When the equipment for which the ground is required is close to a water-pipe, no difficulty is encountered since a water-pipe acts as a splendid ground. It frequently happens, however, that the sub-station or pole at which the ground is to be used is so located as to make it impossible or uneconomical to connect to the nearest water service, or that this method of grounding is prohibited by a local ordinance. In this case some form of ground must be improvised.



Method of Grounding to Corrugated Iron Culvert Pipe. A, Corrugated Culvert Pipe; B, Copper Bus Bar; C, Coke or Charcoal; G, Gravel or Other Pervious Material; P, Pole or Other Equipment Being Grounded; W, Insulated Lead Wire to Equipment

A number of different types of grounds have been devised for use under such circumstances, among these being the buried copper plate with connecting wire, or a number of wrought iron water pipes or rods driven into the ground and bonded together with copper wire. Another type of ground which departs from the ordinary in its construction but which has proven to be entirely satisfactory was devised some years ago by L. E. Marshall, General Superintendent of the Ohio Gas & Electric Co., now part of the Columbia System. The type devised by Mr. Marshall is so ingenious and so effective and yet so simple that it merits a description.

This ground consists primarily of a corrugated iron culvert pipe about 8 or 10 ft. long set vertically at the base of the pole or near whatever equipment it serves. Several simple features, however, add to its effectiveness. The first of these is bonding the riveted sections of culvert pipe by means of a copper bus bar or wire soldered to each section. This need not be elaborate; any scrap material may be used. Likewise the matter of contact between culvert pipe and earth is worthy of consideration. It has been found that a lining of charcoal or coke at the base and next to the inside and outside of the pipe, and the remainder of the inside of the pipe filled with pervious material insures a wet condition that adds to the electrical conductivity of the pipe. The addition of salt to the material at base of the pipe adds even more to effect of this wet condition.

But what are the advantages of this type of ground over other types? The first and most important of these is its high electrical conductivity, which may be attributed to both the material in the culvert pipe and the way in which the pipe is constructed and installed. As everybody knows, pure iron is a good conductor of electricity, so in order to get the full effect of this condition the culvert pipe used is made of Armco ingot iron. The zinc used for galvanizing this type of pipe is also a good conductor. Moreover, the construction of the pipe adapts it for this service. The cylindrical form and the corrugated construction probably insure the greatest area of contact per unit of weight between the pipe, both inside and outside, and the adjacent soil, that can be found. The well action of the cylindrical form also helps in maintaining the desirable wet condition around the pipe.

Hardly less important than the conductivity are the strength and reliability of this type of ground. It is not dependent for its effectiveness on unprotected underground wires that are likely to become severed. Nor, if in digging around the pole, the pipe is struck or even pierced, is its conductivity materially impaired, because the effect of contact near the surface of the ground is usually negligible. Being inside the pipe, the bonding bar or wire is protected against injury from digging tools.

And now as to the diameters of pipe used. It has been found that an 8-in. pipe is sufficient as a ground for lightning arresters on feeders at underground terminal poles. However, at more important points such as at main sub-stations where the pipe is used for grounding transmission line lightning-arresters or the neutral on star-connected transformer banks, a larger diameter, 15-in. or 18-in., is desirable.

As already mentioned, this type of ground has been very satisfactory. Moreover, an examination of culvert pipes installed for this purpose more than six years ago shows them to be entirely free from corrosion, giving promise of almost indefinite service.

Traveling Water Screens

Interesting Installation at City of Minneapolis New Filtration Plant

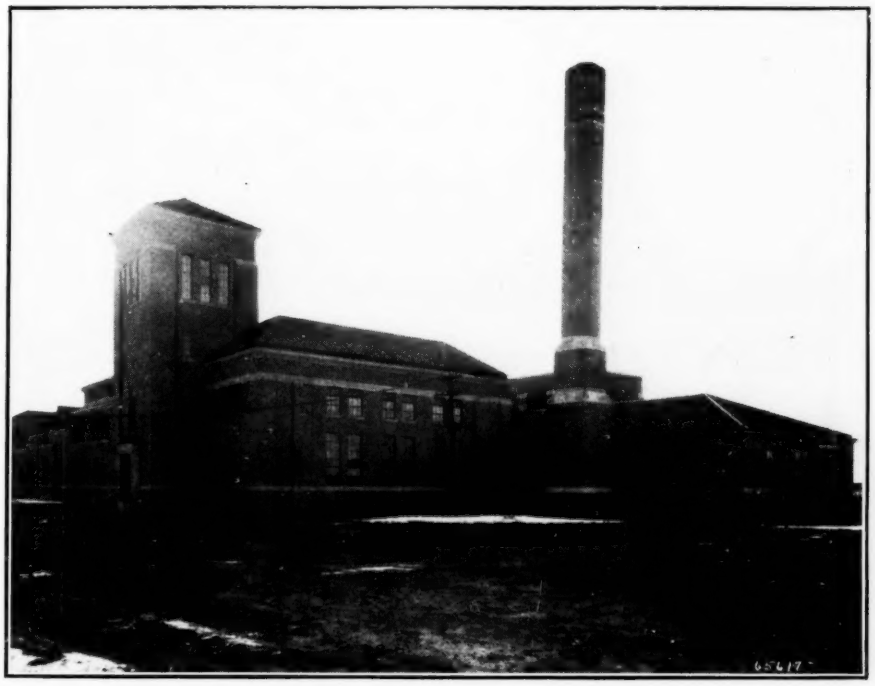
By F. S. VAN BERGEN

The City of Minneapolis is just completing a new Filtration Plant, which although not approaching in size some of the plants in larger cities, is nevertheless a most modern and imposing station. The plants at Buffalo and St. Louis and in fact some other cities are far larger, but no more attractive or better equipped.

This new Minneapolis station consists of two distinct buildings, one the Filtering Plant proper and the other the Pumping Station, the buildings being located about a half a mile apart, with the Pumping Station at a somewhat lower elevation than the Filtering Plant.

In the Pumping Station the City has installed two Vertical Rex Traveling Water Screens, each with a capacity of approximately 40,000 gallons per minute. These screens are designed for 25½ ft. centers, and carry 8 ft. baskets made of No. 12 B & S Gauge Copper Wire. Eventually three more similar screens will be installed, and in fact screen chambers have already been constructed for this additional equipment. These provisions have been made in order to take care of future demands on the plant due to the growth of the ctiy.

The purpose of screening the water is to prevent debris such as leaves, fish, chips, etc., as well as trash ice (principally the latter) from getting through into the pumps, and of course there is to be considered also the fact that screened water, being practically free from debris, is much more readily filtered.



View of the Pumping Station and Screen House

The Pumping Station is equipped with two series of electrically driven turbine pumps, one series being of the low pressure type used in taking the screened water from the river and pumping it to the Filtration Plant proper, where it is filtered, and then delivered by gravity back to the pumping station, where it enters the second series of pumps which are of the high duty type, and are used to deliver the water to the city.

The Mississippi River always has been and probably always will be our source of water supply here. Prior to the year of 1910 no provision was made by the city to filter the water, the water being taken directly from the river in its raw state and delivered directly to the consumer. Many cities have used lake water for their direct supply without any serious results, but lake water cannot be compared as to impurities with river water, the latter being contaminated on account of sewage emptied into it from points higher up, and this contamination being carried in suspension without any chance of deposit.

Epidemics of typhoid and other illness caused by impure water, made some steps necessary here to better the condition, and in the year 1910 the city began chlorinating the water before delivering it, and for this purpose they built what is known as the Columbia Heights Pumping Station, with a capacity of about 25 million gallons per day. In 1913 due to the rapid growth of the city, the capacity was increased to 40 million gallons per day, —in 1915 to 57 million gallons per day, and again in 1920 to 78 million gallons per day, all of these increases being made at the Columbia Heights plant.

A couple of years ago, it was clearly evident that in order to take care of the rapid increase in water consumption, it was going to be necessary to install a complete new plant, and the result was this new lay-out, which is called the Fridley Filtration Plant of the City of Minneapolis.

The plant has been erected at a cost

The Filtration House Installation Treats the Raw Water by Modern Method

General View of the Screens That Remove Coarse Material From the Raw Water

of approximately $2,500,000.00, the pumping station costing $630,000.00, and the filtartion plant proper about $1,870,000.00, with a capacity of approximately 118,000,000 gallons of filtered water per day.

This plant has been tied in with the Columbia Heights plant, which is about three miles distant from it, so that both plants deliver water simultaneously, or either plant can act as an auxilliary should one of them be down.

Court Decisions on Water Works and Sewerage

From Public Health Reports of U. S. Public Health Service

Sewage Pollution of Stream by City.—(Connecticut Supreme Court of Errors; Donnelly Brick Co., Inc., v. City of New Britain, 137 A. 745; decided June 6, 1927.) In an action brought against the city of New Britain because of damage to plaintiff's property caused by the pollution of a brook and the overflow of its polluted waters, the supreme court of errors stated the applicable principles of law as follows:

> The plaintiff was entitled, as a riparian owner, to have this brook flow through its land as it had been accustomed to flow, as a right inseparately annexed to its soil. Nolan v. New Britain, 69 Conn., 668, 681, 38 A. 703. The defendant city had no right to appreciably or materially pollute the brook and thus cause a nuisance and impair plaintiff's right in it. Stamford Extract Mfg. Co. v. Stamford Rolling Mills Co., 101 Conn. 310, 322, 125 A. 623. "If a municipal corporation, in the absence of a legal right so to do, causes sewage to pollute a watercourse, to the use of which a lower owner, through whose premises the watercourse flows, is entitled, it is guilty of a nuisance, for which damages may be recovered." Nolan v. New Britain, supra, at page 678 (38 A. 706.) * * * * * * The city could not support its pollution of this stream upon the ground of its public necessity. * * *

Referendum Not Allowable in Case of an Ordinance Declared to be an Emergency Measure and in the Interest of Public Health.—(Ohio Supreme Court; State ex rel. Smith v. City of Fremont, 157 N. E. 318; decided May 11, 1927.) On June 12, 1926, the State department of health, finding that the public water supply of the city of Fremont was impure and dangerous to health, ordered the city to change the source of its water supply or to install satisfactory purification works. The city was given a year in which to comply with the order.

On June 15 an ordinance, providing for the issuance of bonds to pay for the installation of a filtration plant, was introduced in the city council, and on June 29 the said ordinance was adopted.

On June 28 more than 10 per cent of the duly qualified electors of the city filled an initiative petition, providing for the drilling of additional deep wells and for a change of the source of the city's water supply from the Sandusky River to certain deep wells then owned by the city and to such other wells as might be necessary. This initiated ordinance was approved by the required vote at a general election held on Nov. 2.

On August 3 the city council passed another ordinance authorizing the director of public service to advertise for bids and to contract for the construction of the filtration plant, and on September 8 a contract was awarded in accordance with plans and specifications approved by the State department of health.

In a mandamus proceeding against the city, the supreme court was asked for an order directing the defendant to employ an experienced deep-well driller and contractor for the purpose of drilling wells and constructing an emergency reservoir and equipment, as provided in the initiated ordinance adopted on Nov. 2.

The court, with two justices dissenting, held that, since the city council had declared the ordinance adopted on June 29 to be an emergency measure and in the interest of public health and safety, there could be no referendum under the State constitution. The court stated:

> The effect of the initiative petition and its subsequent adoption by the people would be nothing less than a referendum upon the measure adopted by the city council. It is the invoking of initiative legislation as a substitute for and in lieu of a referendum; it is an attempt to repeal legislative action by invoking initiative action.

Portable Alternating-Current Instruments

A new type of portable alternating-current instruments, designated as Type AS-2, has been announced by the General Electric Company. These instruments, compact in construction, were designed for general testing and inspecting work in industrial plants and power stations. They are repulsion type instruments and, while primarily intended for use on alternating-current circuits, can also be used to advantage on direct current.

Both ammeters and voltmenters are supplied, and both are double rated. Ammeters are supplied self-contained in ratings not exceeding 20 amperes. For higher ratings, 5-ampere instruments should be used with current transformers. Voltmeters are supplied self-contained in ratings not exceeding 300 volts. For higher voltage ratings, external portable multipliers are supplied.

The scale length is approximately 3 in., and is quite open at the central and upper portions. The case and cover are of moulded bakelite, made to resemble Morocco leather. The cylindrical switch and binding posts are below the scale. and are protected by a hinged cover with a snap lock. The moving element is light in weight, the pointer is sturdy, and the element is effectively damped. Each instrument is provided with a zero adjusting advice. The operating screw of this device projects through the case in such a manner that it is well protected but still accessible. The instrument weighs 18 ounces. It is designed to fit in the coat pocket but, where desired, a leather carrying-case with shoulder strap can be supplied. It measured 5¼ by 3½ by 1⅞ in., and is finished in brownish-red with nickel trimmings.

Lighting of Traffic Arteries

Important Elements in Design of System of Illumination for a Traffic Artery

By A. F. DICKERSON
Chief Engineer, Illuminating Engineering Laboratory, General Electric Co.

With the ever-increasing night traffic on our streets and highways, the use of light, as a protective measure, is being overshadowed by its absolute necessity to insure high-speed traffic with safety. Traffic counts on most of our radial arteries will show maximum peaks between 5 and 6:30 o'clock in the evening. In the winter these are hours of darkness or twilight. Lower peaks usually occur in the evening between 7 and 8 o'clock. On many streets the average hourly night traffic to midnight exceeds that of the daylight hours. More than half of the accidents on these streets occur after sundown.

Traffic Control.—Traffic control or regulation is designed to relieve congestion. During times of peak traffic, congestion is relieved principally by increasing average speed. By systems of progressive control, cars on main thoroughfares may maintain speeds higher than 25 miles an hour with safety in daylight. At night, unless sufficient lighting of the proper kind is supplied, drivers automatically decrease their speed below that for which the control system has been set, resulting in frequent stops with accompanying congestion. If an attempt is made to maintain the prescribed high speed on the poorly lighted street, frequent accidents will follow.

In a recent count on one of the main traffic arteries of a city of 100,000 it was found that approximately 20,000 persons in automobiles passed a certain point during 24 hours.

If traffic control will save five minutes in traversing this street, the daily saving would be over 1,600 man hours. When the magnitude of this possible saving is realized even though reduction in accidents is not considered, there can be no excuse for not installing a traffic control system.

A traffic control system is installed by a city and if accidents result from the increased speed permitted, the city's government is morally responsible and should take steps to correct the situation. One of the first steps should be to light the street adequately. This lighting is a function of the city and not of the abutting property owners. Increased traffic, excepting on a business street, is generally a detriment to abutting property and the cost of the lighting which will tend to increase traffic should be borne entirely by the city. If the property owners demand standards and fixtures of a highly ornamental nature, then perhaps they should share in the installation expense.

Municipal Street Lighting Budgets.—This brings up the question, should municipal street lighting budgets be increased and what is a fair yearly expenditure per capita for street lighting?

The following chart shows the comparative expenditures during 1919 and 1924 for the various departments of all cities in the United States of over 30,000 population. This information was compiled from reports of the Census Bureau, 1924 being the latest report.

	1919 Per cent	1924 Per cent
Street Lighting	3.4	2.4
Highways	9.6	8.05
Charities Hospitals Correction	7.3	5.9
Schools	31.7	37.9
Libraries	1.3	1.2
Recreation	3.4	3.3
Misc. and General	4.7	4.7
General Government	10.2	8.5
Health Conservation	2.7	2.7
Sanitation	8.1	7.6
Police	10.8	10.3
Fire	8.46	8.2
Other Protection	1.74	1.65

An examination of these charts discloses the fact that while the general per capita cost of government has risen over 68 per cent in the 5-year period, expenditures for street lighting have only gone up less than 21 per cent. In 1919 our streets were inadequately lighted and we were spending 3.4 ct. of every tax dollar for street lighting. After five years of tremendous expansion in motor transportation we find this figure reduced to 2.4 ct.

Some may point to these figures with pride. Such a remarkable saving! But is this saving justified when one considers the enormous loss in time due to congestion and slow speed, and the great increase in night accidents with the resulting injuries, deaths, and property damages.

Per Capita Expenditure for Street Lighting.—The average annual per capita expenditure for street lighting in the cities of this country with over 30,000 population was 87 cents in 1924 and is probably about 95 cents now. It would be far better economy to spend two dollars. The over-all service purchased by the $7.15 spent for safety and protection in 1924, could have been greatly improved by a re-allotment which would have increased the street-lighting budget.

There are a few large cities now spending over $2 per capita for street lighting and many more have approved plans which will call for such an expenditure. The average for the best lighted fifty cities in this country is now about $1.50. The yearly cost of street lighting will vary from about two cents per linear foot of street for the poorly lighted village to nearly fifteen dollars for an intensive "White Way" system such as is on State Street, Chicago. If it is a good investment for a property owner or merchant to pay fifteen dollars for lighting one foot of street, surely it is well worth while for some cities to consider increasing their present expenditures.

Night Street Accidents.—It is a well-known fact that light increases the speed of vision and is, therefore, an aid in speeding up traffic. Statistics prove that night street accidents are also materially reduced by light. In the city of Cleveland there are several major thoroughfares leading east with double track street car lines. In 1923, statistics showed one night fatality on Euclid Ave. and one on Woodland, both of which were well lighted, while there were eight on Superior and seven on St. Clair where there was poor lighting. This was true in spite of the fact that in the daytime more people were killed on the first two streets. More than two years ago Superior Avenue was brilliantly lighted with a system of 25,000-lumen lamps and since then there has not been a night fatality.

Recent statistics from a large number of cities show that approximately 20 per cent of our night traffic fatalities are directly due to insufficient street illumination. In Cleveland, estimates indicate that the proper lighting of all the streets would save 33 lives each year, or 39 per cent of the total killed in automobile night accidents.

The quantity of light and the type of lighting to be used on a traffic artery will depend largely on local conditions, amount of traffic, tree interference, street surface, and many other factors. In this paper only general recommendations for average conditions will be given.

Visibility of Prime Importance.—In appraising a street lighting system, visibility is of prime importance. The amount of light reflected by an object in the direction of the eye is not a measure of its visibility. In other words, photometers do not measure visibility. Our vision does depend on the brightness of the retinal image and this brightness is in proportion to the amount of light that enters the pupil of the eye. The normal pupillary opening can contract to one sixty-fourth of its greatest dilation; so it is quite apparent that the visibility of an object will be greatly lessened by anything that tends to close this opening. This explains the importance of reducing glare, in so far as possible, on city streets.

Today the greatest glare factor on our traffic arteries is the automobile headlight. Steps are being taken to curb this evil, even to the extent of compulsory dimming; so lighting systems should be designed to reduce glare to the practical minimum even though it may not be objectionable under present conditions. All modern automobiles are equipped with visors which cut off the street luminaries long before the maximum ray is intercepted.

In classifying street lighting the term "average horizontal foot-candles" is sometimes used. This is faulty as it does not take into account many important factors such as glare, brightness, and distribution of light.

The term "lumens per linear foot" which is more often used, is a measure of light output and while it does not take into account the proportion of light which reaches the street surface, it is a convenient measure of the comparative value of systems when used in connection with properly designed street lighting. This value is easily obtained by dividing the total bare-lamp lumens of each standard by the number of linear feet of street per standard, or the total lumens of all the lamps by the linear feet of street lighted.

Recommendations for Average Traffic Artery. — Traffic streets should be lighted to a sufficient degree to permit the operation of motor vehicles without bright headlights. The amount of light necessary will vary from a minimum of about 40 lumens per linear foot to a maximum of several hundred for the wide streets with heavy traffic. Table I of recommendations covers good lighting on the average traffic artery in the classification indicated:

Table I

Lighting Recommendations	Classification of Population: Over 100,000	30,000 to 100,000	Below 30,000
Lumens of lamp	60,000-10,000-15,000	6,000-10,000	6,000
Arrangement of standards	Staggered	Staggered	Staggered
Feet of street per standard	75-150	100-150	100-150
Lumens per linear foot	60-200	40-100	40-60
Height of upright unit	15-18 ft.	15-18 ft.	15-18 ft.
Height of Pendent unit	20-25 ft.	20-25 ft.	20-25 ft.

Considerable leeway is given in the above table but deviations from it will often be advisable. For instance, very wide thoroughfares in large cities will probably demand an opposite arrangement of standards and in some cases the installation of two-light standards may be advisable. From a strictly utilitarian viewpoint the system with pendent units is the more efficient. With the higher mounting heights, spacings can be materially increased and larger lamps used.

In all pendent fixtures and in most upright units refractors or reflectors can be used to advantage. Where light on buildings or porches is objectionable, it should be refracted or reflected into the street. Some light on buildings and in trees is necessary in the reduction of glare by lessening the contrast between the luminaire and its background. Such light also adds to the cheerfulness of the street. Sidewalk lighting with minimum shadows is necessary and a certain amount of light between buildings is essential for protective purposes.

There is a variety of luminaires and standards that have been designed primarily for the lighting of thoroughfares. In general they should be inconspicuous but pleasing in contour to the observer. Illuminating efficiency is of paramount importance. Fortunately, beauty in design does not necessarily detract from this feature nor does it make the equipment more expensive.

Once a system of lighting is installed, constant attention to its proper maintenance will prove good economy. It is not uncommon to see street lighting fixtures operating at half their initial efficiency because of the accumulation of dirt, the improper adjustment of refractors and reflectors, or the burning of lamps long beyond their rated or economical life. Proper maintenance may not cost more than five per cent of the total expense of the system but improper maintenance might, and often does increase the cost of useful delivered light by 50 per cent.

Highway Lighting.—While it is intended that this article shall primarily deal with the lighting of traffic arteries within the city limits, it would be incomplete without some mention of highway lighting. Because of the increased speed and also the proximity of opposing traffic lanes with the resultant danger from headlight glare, serious accidents to the occupants of automobiles are more common on the highway than on the city street. That highway traffic can be speeded up safely and with more comfort to the driver under properly designed systems of illumination has been conclusively proven in many instances.

In summary, it is hoped that this article has pointed out: first, the usefulness of systems of traffic control; second, the resulting need of good lighting in order that they may properly function; third, the necessity of such lighting if night accidents are to be reduced; and fourth, the relatively small expense of good lighting and the justification of an increase in present expenditures.

In conclusion, an effort has been made to indicate the important elements in the design of a system of illumination for a traffic artery. The recommendations included must, of a necessity, be of a general character. However, they can be readily adapted or altered to conform to local conditions.

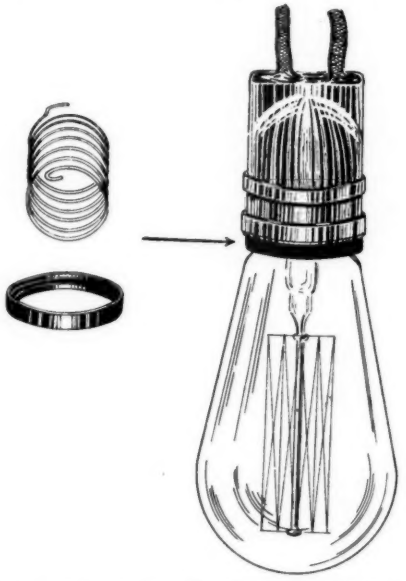
Western Road and Equipment Exposition.—An exposition for construction equipment used by road builders and general contractors will be held March 7-11 at Los Angeles, Cal. The exposition will be conducted by the Western Construction Equipment Distributors, Inc., which includes the principal machinery dealers of Seattle, Portland, Salt Lake City, Boise, Phoenix, Denver, San Francisco and Los Angeles. Arthur E. Welch, 807 Union League Bldg., Los Angeles, Cal., is secretary.

Lock For Weather-Proof Sockets

The prevention of lamp thefts from moulded composition, weatherproof sockets has now been made possible by the Ren Mfg. Co., of 410 Main St., Winchester, Mass., makers of Ren-Locks, with the co-operation of one of the largest manufacturers of electric light sockets, according to a recent announcement.

Hundreds of thousands of Ren-Locks are said to have been installed in brass and porcelain sockets during recent years. It is now possible to obtain the new Hubbell No. 43310 and Hubbell No. 60666 (with shade-holder groove) moulded composition sockets, to which Ren-Locks can be attached.

There is only one style of Ren-Lock. It consists of a coiled spring and a



This New Lamp Lock Prevents Thefts From the Job

grooved ring. There is only one style of punch, which is used to apply the lock to the socket. A purchaser of Ren-Locks (which are sold direct to the consumer only) can use them interchangeably on all brass and porcelain sockets and receptacles, and on Hubbell weatherproof sockets. This news will be of particular interest to builders and construction companies.

The Ren-Lock has no unsightly cage to catch dust and cast shadows. There is no key to be lost, stolen or imitated. It grips the base of the lamp, and therefore one size Ren-Lock will fit all sizes of lamps, having the medium size base. It can be used over and over again, so that if it saves one lamp in the course of its life-time, the Ren-Lock will more than pay for itself, say the manufacturers.